

THE HOLOTHURIOIDEA COLLECTED BY THE
VELERO III AND IV DURING THE YEARS
1932 TO 1954

PART II. ASPIDOCHIROTA

(PLATES 1-9)

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INTRODUCTION

No other tropical coast has ever been so well explored for shallow water holothurians as the Panamic region of the west coast of America, where the Hancock expeditions have collected for more than a decade. The report on the dendrochirotes, 1941, included about 40 species, of which many were new, and in most cases it was possible to outline the distribution for each species with some accuracy. The collections of aspidochirote forms are not so rich in species—only about half as many as the dendrochirotes, and few are new—but the enormous amount of material (some thousand individuals) has helped to clarify our ideas about these widespread forms, their distribution, their ecological demands, and the relationships of the Panamic shore fauna to that of the West Indies and the outposts of the West Pacific.

Like the dendrochirote forms, the aspidochirotes were almost unknown in that part of the world thirty years ago. Mortensen's few collecting trips in the Gulf of Panama, in 1916-1917, gave the first inkling of how much existed in that apparently barren region. One hesitated then to give names to these various species, as the few known forms were inadequately described and it seemed impossible that some of the more striking ones of those collected were not known from other parts of the world. Hence the publication of the report on his material was shelved for the time being.

A large amount of the Hancock material was identified in 1933, shortly after it had been collected, and more was worked over during my various visits to California in the following years. During this time short reports were published on material received from other expeditions (*Zaca*, *Arcturus*, *Stranger*, etc.), slowly adding to the handful of species hitherto listed. A preliminary report on the Hancock collections was

compiled and deposited in the Foundation during the war*. Finally, in the winter of 1954-55, I was given an opportunity to spend three months at the Hancock Foundation going through the entire collection and finishing the report.

I beg the authorities of the Hancock Foundation to accept my sincere thanks for the privilege of studying this unique collection, and for all the help and encouragement received during my most happy visit. In particular I wish to thank Captain Allan Hancock, whose unflagging interest in marine life has given an impetus to the study of the west coast invertebrates which can be compared only to that given by Alexander Agassiz through his *Albatross* expeditions in the latter part of the last century.

STATION LIST

To eliminate duplication and the tedious work of co-ordinating widely scattered locality records, the stations are here arranged geographically instead of chronologically.

First on the list are placed the outlying islands, those which most likely have served as steppingstones for the Indo-West Pacific forms which have been able to cross the eastern Pacific: the Galapagos Islands, Cocos Island, and the Revilla Gigedo islands, Clarion and Socorro. The Clipperton Islands are not included as no aspidochirote holothurians were collected there by the Hancock expeditions, but they are mentioned under the distribution of the individual species. In the Galapagos Islands it has been found most practical to arrange the large number of stations alphabetically under each island, beginning with Albemarle and ending with Tower.

Along the mainland, the stations are arranged from south to north, the units being Peru, Ecuador, Colombia, Costa Rica, the exposed part

*A preliminary list was compiled by Domantay and, unfortunately, rather hurriedly published by him in 1953 without having any of the supposedly new records checked with older material. Of the genus *Holothuria* he lists 43 species and varieties, which subsequent examination has reduced to 20. His seven new species and varieties are complete *nomina nuda* with not even a locality record given, and these names must therefore be rejected once and for all. Most of the supposedly new forms, as well as the 16 older species hitherto known only from other parts of the world, have proved to be juvenile or atypical individuals of species already known from the Panamic region.

From the Atlantic cruises he lists 10 aspidochirotetes, of which he considers seven common to both the Atlantic and the Pacific Oceans. His *Holothuria atra* from Florida proved, however, to be a dark-skinned *H. floridana* which had been preserved for a short time in formalin, causing the skin to be unusually smooth. His other species, except *H. arenicola* and *H. impatiens*, are considered distinct from those in the Panamic region.

of the Mexican coast to Isabel Island, designated as Mexico; and the northern part divided into the Gulf of California and the West coast of Lower California, including Guadalupe Island.

The species are arranged in the same order as they appear in this paper.

The region explored is a fairly natural province with the fauna most richly developed in the sheltered Gulf of California and in the Archipelago of the Galapagos Islands, and dropping off sharply southwards toward Peru and northward on the exposed western shore of Lower California.

Locality	Position	Station and date	Depth and bottom	Species collected
Galapagos Islands Albemarle Island Albemarle Point	0° 09' 00" N 91° 23' 00" W	69-33 Feb. 11, 1933	shore, rock, tide pools	<i>Isostichopus fuscus</i> <i>Brandothuria impatiens</i> <i>Semperothuria imitans</i>
Albemarle Point	0° 09' 00" N 91° 23' 00" W	146-34 Jan. 12, 1934	shore, rock, tide pools	<i>Microthele difficilis</i> <i>Brandothuria arenicola</i> <i>Brandothuria gyryfer</i> <i>Lessonothuria pardalis</i> <i>Mertensiothuria leucospilota</i> <i>Ludwigiothuria kefersteini</i> <i>Selenkothuria theeli</i>
Cartago Bay	0° 34' 10" S 90° 57' 55" W	73-33 Feb. 13, 1933	shore, rock, sand, mangroves	<i>Microthele difficilis</i> <i>Brandothuria impatiens</i> <i>Semperothuria imitans</i> <i>Ludwigiothuria kefersteini</i>
Cartago Bay	0° 34' 10" S 90° 57' 55" W	76-33 Feb. 14, 1933	shore, sand	<i>Isostichopus fuscus</i> <i>Brandothuria impatiens</i> <i>Semperothuria imitans</i> <i>Ludwigiothuria kefersteini</i> <i>Selenkothuria theeli</i>
Cartago Bay	0° 34' 10" S 90° 57' 55" W	800-38 Jan. 22, 1938	north shore, rock	<i>Brandothuria arenicola</i> <i>Brandothuria impatiens</i> <i>Brandothuria gyryfer</i> <i>Lessonothuria pardalis</i> <i>Semperothuria imitans</i> <i>Ludwigiothuria atra</i> <i>Ludwigiothuria kefersteini</i> <i>Fossothuria rigida</i>
Cartago Bay	0° 34' 10" S 90° 57' 55" W	188-34 Jan. 25, 1934	north shore, rock, sand	<i>Brandothuria arenicola</i> <i>Lessonothuria pardalis</i> <i>Ludwigiothuria atra</i> <i>Selenkothuria theeli</i>

East of south end	1° 04' 00" S 90° 39' 00" W	192-34 Jan. 27, 1934	120 fms rough rock	<i>Vaneothuria zacae</i> f. <i>azacae</i>
Tagus Cove	0° 16' 06" S 91° 22' 31" W	150-34 Jan. 13, 1934	shore, rock	<i>Selenkothuria theeli</i>
Tagus Cove	0° 16' 13" S 91° 22' 41" W	9 Jan. 4-9, 1932	shore	<i>Selenkothuria theeli</i>
Tagus Cove	0° 16' 16" S 91° 22' 39" W	330-35 Dec. 10, 1934	12 fms, sand, nullipores	<i>Jaegerothuria inahabilis</i>
Between Albany and James Island	0° 10' 45" S 90° 52' 08" W	183-34 Jan. 24, 1934	50-70 fms rock, shell	<i>Vaneothuria zacae</i> f. <i>azacae</i> <i>Jaegerothuria inahabilis</i>
Barrington Island	0° 51' 35" S 90° 02' 00" W	47-33 Feb. 2, 1933	2 fms	<i>Brandtothuria impatiens</i>
Barrington Island	0° 51' 35" S 90° 02' 00" W	48-33 Feb. 2, 1933	shore, rock	<i>Brandtothuria arenicola</i> <i>Brandtothuria impatiens</i> <i>Selenkothuria theeli</i>
Barrington Island	0° 51' 35" S 90° 02' 00" W	811-38 Jan. 26, 1938	shore, <i>Pocillopora</i> coral	<i>Brandtothuria arenicola</i> <i>Brandtothuria impatiens</i> <i>Semperothuria imitans</i>
Bartholomew Island, near James Island	0° 17' 00" S 90° 34' 45" W	179-34 Jan. 23, 1934	shore, lava rock	<i>Selenkothuria theeli</i>
Bartholomew Island, near James Island	0° 17' 00" S 90° 34' 35" W	244-35 Dec. 12, 1934	shallow water coral	<i>Ludwigothuria kefersteini</i>
Bindloe Island	0° 20' 45" N 90° 33' 00" W	306-35 Dec. 2, 1934	reef, lava rock	<i>Brandtothuria arenicola</i> <i>Selenkothuria theeli</i>
Charles Island				
Black Beach	1° 17' 38" S 90° 29' 55" W	166-34 Jan. 12, 1934	shore, rock	<i>Brandtothuria arenicola</i> <i>Semperothuria imitans</i> <i>Selenkothuria theeli</i>
Black Beach	1° 17' 38" S 90° 29' 55" W	199-34 Jan. 30, 1934	shore, rock	<i>Microthele difficilis</i> <i>Brandtothuria arenicola</i> <i>Brandtothuria impatiens</i>

Locality	Position	Station and date	Depth and bottom	Species collected
Black Beach	1° 17' 38" S	313-35	shore, rock	<i>Brantothuria arenicola</i> <i>Brantothuria impatiens</i> <i>Ludwigothuria kefersteini</i> <i>Selenkothuria theeli</i> <i>Selenkothuria portovallartensis</i>
	90° 29' 55" W	Dec. 6, 1934		
Black Beach	1° 16' 36" S	803-38	shore, rock	<i>Semperothuria imitans</i> <i>Ludwigothuria kefersteini</i> <i>Selenkothuria theeli</i> <i>Selenkothuria portovallartensis</i>
	90° 29' 52" W	Jan. 23, 1938		
South of Black Beach	1° 19' 40" S	351-35	shore, turnable rocks	<i>Isostichopus fuscus</i> <i>Brantothuria arenicola</i> <i>Semperothuria imitans</i> <i>Selenkothuria theeli</i>
	90° 13' 15" W	Dec. 14, 1934		
Northwest of Post Office Bay	1° 09' 40" S	198-34	55-65 fms sand	<i>Vaneyothuria zacae</i> f. <i>azacae</i>
	90° 33' 00" W	Jan. 29, 1934		
Chatham Island Stephens Bay	0° 47' 30" S	170-34	32 fms, fine sand, corallines	<i>Brantothuria arenicola</i>
	89° 31' 00" W	Jan. 21, 1934		
Wreck Bay	0° 53' 55" S	354-35	shore, rock	<i>Selenkothuria theeli</i>
	89° 36' 35" W	Dec. 15, 1934		
Duncan Island	0° 25' 20" S	80-33	shallow water, coral	<i>Brantothuria impatiens</i>
	90° 45' 50" W	Feb. 15, 1933		
Hood Island Osborn Island, Gardner Bay	1° 22' 52" S	24-33	shore, rock	<i>Labidodemas americanum</i> <i>Microthele diffictis</i> <i>Selenkothuria theeli</i>
	89° 39' 15" W	Jan. 24, 1933		
Osborn Island, Gardner Bay	1° 22' 52" S	359-35	shore, rock	<i>Labidodemas americanum</i> <i>Brantothuria arenicola</i> <i>Brantothuria impatiens</i> <i>Semperothuria imitans</i> <i>Ludwigothuria kefersteini</i> <i>Selenkothuria theeli</i>
	89° 39' 15" W	Dec. 19, 1934		

Osborn Island, Gardner Bay	1° 22' 52" S 89° 39' 15" W	202-34 Jan. 31, 1934	shore, rock	<i>Brandtothuria impatiens</i> <i>Ludwigothuria kefersteini</i> <i>Selenkothuria theeli</i> <i>Selenkothuria portovallartensis</i>
Gardner Bay	1° 22' 18" S 89° 39' 15" W	357-35 Dec. 17, 1934	shallow water, coral	<i>Isostichopus fuscus</i> <i>Brandtothuria impatiens</i>
Gardner Bay	1° 22' 30" S 89° 40' 23" W	358-35 Dec. 17, 1934	shore, rock	<i>Brandtothuria arenicola</i> <i>Selenkothuria theeli</i>
Gardner Bay	1° 22' 07" S 89° 39' 58" W	362-35 Dec. 19, 1934	20 fms, rock, kelp, algae	<i>Isostichopus fuscus</i>
Off Gardner Bay	1° 21' 55" S 90° 40' 05" W	201-34 Jan. 31, 1934	25-35 fms, rock	<i>Vaneothuria zacae</i> f. <i>azacae</i>
North of Hood Island	1° 21' 55" S 90° 40' 05" W	814-38 Jan. 28, 1938	20-40 fms, shell	<i>Vaneothuria zacae</i> f. <i>azacae</i>
Indefatigable Island				
Academy Bay	0° 45' 14" S 90° 20' 11" W	168-34 Jan. 20, 1934	shore, rock	<i>Brandtothuria impatiens</i> <i>Ludwigothuria kefersteini</i> <i>Selenkothuria portovallartensis</i>
Academy Bay	0° 45' 14" S 90° 20' 11" W	314-35 Dec. 7, 1934	shore, rock	<i>Brandtothuria arenicola</i> <i>Brandtothuria impatiens</i> <i>Semperothuria imitans</i> <i>Ludwigothuria kefersteini</i> <i>Selenkothuria theeli</i> <i>Selenkothuria portovallartensis</i>
Conway Bay	0° 32' 00" S 90° 33' 10" W	11 Jan. 12-14, 1932	shore	<i>Brandtothuria impatiens</i> <i>Semperothuria imitans</i>
Conway Bay	0° 31' 25" S 90° 32' 15" W	82-33 Feb. 17, 1933	shore of small island, rock	<i>Selenkothuria theeli</i>
James Island				
James Bay	0° 12' 02" S 90° 52' 08" W	10 Jan. 9-12, 1932	shore	<i>Selenkothuria theeli</i>

Locality	Position	Station and date	Depth and bottom	Species collected
west coast of James Island	0° 16' 10" S	333-35	shore, rocky ledges	<i>Isostichopus fuscus</i> <i>Brantothuria arenicola</i> <i>Semperothuria imitans</i>
	90° 53' 45" W	Dec. 10, 1934		
Sullivan Bay	0° 17' 00" S	343-35	shore, rock	<i>Isostichopus fuscus</i> <i>Microthele difficilis</i> <i>Brantothuria arenicola</i> <i>Brantothuria impatiens</i> <i>Semperothuria imitans</i> <i>Ludwigothuria atra</i> <i>Selenkothuria theeli</i>
	90° 35' 13" W	Dec. 12, 1934		
Sullivan Bay	0° 17' 00" S	796-38	shore, rock	<i>Isostichopus fuscus</i> <i>Microthele difficilis</i> <i>Brantothuria impatiens</i> <i>Semperothuria imitans</i> <i>Ludwigothuria atra</i> <i>Selenkothuria portovallartensis</i> <i>Fossothuria rigida</i>
	90° 35' 13" W	Jan. 21, 1938		
North Seymour Island	0° 23' 15" S	175-34	shore, rock	<i>Brantothuria arenicola</i> <i>Selenkothuria theeli</i> <i>Ludwigothuria kefersteini</i>
	90° 19' 25" W	Jan. 22, 1934		
South Seymour Island	0° 24' 20" S	174-34	shore, rock, sand	<i>Isostichopus fuscus</i> <i>Brantothuria arenicola</i> <i>Semperothuria imitans</i> <i>Ludwigothuria kefersteini</i>
	90° 20' 00" W	Jan. 22, 1934		
South Seymour Island	0° 24' 20" S	789-38	shore, rock, sand	<i>Isostichopus fuscus</i> <i>Brantothuria arenicola</i> <i>Semperothuria imitans</i> <i>Ludwigothuria kefersteini</i> <i>Selenkothuria theeli</i>
	90° 20' 00" W	Jan. 19, 1938		
South Seymour Island	0° 24' 20" S	793-38	shore, rock, sand	<i>Selenkothuria theeli</i> <i>Selenkothuria theeli</i>
	90° 20' 00" W	Jan. 20, 1938		
West of South Seymour Island	0° 24' 20" S	12	shore	<i>Selenkothuria theeli</i>
	90° 20' 00" W	Jan. 14-18, 1932		
Between South Seymour and Daphne Island	0° 24' 25" S	346-35	55 fms mud, shell	<i>Vaneyothuria zacae</i> f. <i>azacae</i>
	90° 21' 50" W	Dec. 13, 1934		

Tower Island									
Darwin Bay	0° 19' 15" N 89° 56' 42" W	13 Jan. 19-24, 1932	shore	<i>Lessonothuria pardalis</i> <i>Selenkothuria theeli</i>					
Darwin Bay	0° 19' 28" N 89° 56' 45" W	93-33 Feb. 22, 1933	shore, lagoon, beach	<i>Lessonothuria pardalis</i> <i>Merteniothuria leucospilota</i>					
Darwin Bay	0° 19' 18" N 89° 57' 14" W	96-33 Feb. 24, 1933	shallow water, rock	<i>Brandtothuria impatiens</i> <i>Ludwigiothuria kefersteini</i> <i>Selenkothuria theeli</i>					
Darwin Bay	0° 19' 18" N 89° 57' 14" W	782-38 Jan. 16, 1938	shore, rocks	<i>Labidomias americanum</i> <i>Microthele difficilis</i> <i>Ludwigiothuria kefersteini</i> <i>Selenkothuria tubrica</i> <i>Selenkothuria theeli</i> <i>Selenkothuria portovallartensis</i>					
Darwin Bay	0° 19' 22" N 89° 57' 02" W	784-38 Jan. 17, 1938	shore, rock	<i>Isostitichopus fuscus</i> <i>Microthele difficilis</i> <i>Brandtothuria impatiens</i> <i>Ludwigiothuria kefersteini</i>					
Cocos Island, Costa Rica									
Chatham Bay	5° 32' 56" N 86° 59' 18" W	778-38 Jan. 14, 1938	shore, rocks	<i>Microthele difficilis</i> <i>Brandtothuria arenicola</i> <i>Brandtothuria impatiens</i> <i>Lessonothuria pardalis</i> <i>Semperothuria imitans</i> <i>Ludwigiothuria atra</i> <i>Selenkothuria theeli</i> <i>Jaegerothuria inhabilis</i> <i>Theelothuria paraprinceps</i>					
Off Nuez Island	5° 34' 00" N 86° 59' 20" W	779-38 Jan. 14, 1938	30-50 fms, rock, coral, corallines						
Clarion Island, Mexico									
Sulphur Bay	18° 20' 05" N 114° 44' 40" W	136-34 Jan. 5, 1934	32 fms nullipores	<i>Selenkothuria portovallartensis</i> <i>Theelothuria paraprinceps</i>					
Sulphur Bay	18° 20' 50" N 114° 44' 10" W	141-34 Jan. 5, 1934	shore, shingle	<i>Brandtothuria arenicola</i> <i>Merteniothuria leucospilota</i> <i>Ludwigiothuria kefersteini</i>					

Locality	Position	Station and date	Depth and bottom	Species collected
Sulphur Bay	18° 20' 50" N 114° 44' 10" W	298-34 Jan. 10, 1934	shore, rock, tide pools	<i>Microthele difficilis</i> <i>Brandtothuria arenicola</i> <i>Selenkothuria lubrica</i>
Sulphur Bay	18° 20' 50" N 114° 44' 10" W	916-39 Mar. 16, 1939	shore, shingle	<i>Microthele difficilis</i> <i>Semperothuria imitans</i> <i>Ludwigiothuria kefersteini</i> <i>Theelothuria paraprinceps</i>
Sulphur Bay	18° 20' 05" N 114° 44' 50" W	917a-39 Mar. 16, 1939	28-35 fms sand, coralline	<i>Theelothuria paraprinceps</i>
North of Clarion Island	18° 23' 45" N 114° 44' 50" W	921c-39 Mar. 17, 1939	35-40 fms nullipores	<i>Theelothuria paraprinceps</i>
Socorro Island, Mexico				
Braithwaite Bay	18° 42' 45" N 110° 56' 50" W	128-34 Jan. 2, 1934	shore, rocks	<i>Ludwigiothuria kefersteini</i> <i>Selenkothuria portovallartensis</i>
Braithwaite Bay	18° 42' 45" N 110° 56' 50" W	130-34 Jan. 3, 1934	shore, rocks, large shingle, tide pools	<i>Brandtothuria arenicola</i> <i>Selenkothuria portovallartensis</i>
East of Cape Rule	18° 42' 25" N 110° 57' 40" W	297-34 June 9, 1934	diving and netting	<i>Isostichopus fuscus</i> <i>Mertensiothuria leucospilota</i> <i>Ludwigiothuria kefersteini</i>
Peru				
SW of Zorritos Light	3° 45' 50" S 79° 47' 00" W	847-38 Feb. 16, 1938	shore, rocks	<i>Ludwigiothuria kefersteini</i> <i>Selenkothuria portovallartensis</i>
Ecuador				
Point Brava, Santa Elena Bay	2° 12' 23" S 81° 00' 05" W	19-33 Jan. 21, 1933	shore, rock	<i>Brandtothuria arenicola</i> <i>Brandtothuria impatiens</i> <i>Selenkothuria lubrica</i>
S of Santa Elena Point	2° 12' 23" S 81° 00' 05" W	207-34 Feb. 8, 1934	shore, rocks	<i>Ludwigiothuria kefersteini</i> <i>Selenkothuria lubrica</i> <i>Selenkothuria theeli</i>

S of Santa Elena Point	2° 12' 00" S 81° 00' 25" W	10-33 Jan. 18, 1933	shore, rocks	<i>Selenkothuria lubrica</i>
Off Santa Elena Bay	2° 08' 20" S 81° 00' 15" W	209-34 Feb. 9, 1934	8-10 fms, rocks, large shells	<i>Jaegerothuria inhabilis</i>
La Plata Island	1° 16' 00" S 81° 05' 10" W	22-33 Jan. 22, 1933	shore	<i>Selenkothuria lubrica</i>
Off La Plata Island	1° 15' 00" S 81° 04' 15" W	212-34 Feb. 10, 1934	45-55 fms rock, mud	<i>Vaneothuria zacae</i> f. <i>typica</i>
W of Manta	0° 56' 43" S 80° 44' 43" W	403-35 Jan. 20, 1935	reef with breakers	<i>Brandtothuria arenicola</i> <i>Ludwigothuria kefersteini</i>
Manta Bay	0° 56' 30" S 80° 44' 18" W	400-35 Jan. 19, 1935	shore, rock, sand	<i>Brandtothuria arenicola</i>
Cape San Francisco	0° 39' 30" N 80° 06' 30" W	848-38 Feb. 23, 1938	shore, rock	<i>Selenkothuria portovallartensis</i> <i>Selenkothuria lubrica</i>
Colombia				
Gorgona Island	2° 58' 00" N 78° 11' 30" W	405-35 Jan. 22, 1935	shore, rock, sand	<i>Brandtothuria arenicola</i> <i>Lessonothuria pardalis</i> <i>Selenkothuria lubrica</i>
Gorgona Island	2° 58' 00" N 78° 11' 50" W	411-35 Jan. 22, 1935	shallow water, coral (<i>Pocillopora</i>)	<i>Brandtothuria impatiens</i>
Gorgona Island	3° 00' 30" N 78° 11' 45" W	853-38 Feb. 24, 1938	shore, rock	<i>Selenkothuria lubrica</i>
Cabita Bay, Cape Corrientes	5° 29' 20" N 77° 29' 35" W	229-34 Feb. 13, 1934	shore near stream, sand	<i>Selenkothuria lubrica</i>
Port Utria	5° 59' 10" N 77° 21' 20" W	413-35 Jan. 23, 1935	shore, rock	<i>Brandtothuria arenicola</i> <i>Selenkothuria lubrica</i>
Port Utria	5° 59' 10" N 77° 20' 20" W	232-34 Feb. 14, 1934	shore, rock	<i>Brandtothuria arenicola</i> <i>Irenothuria maccullochi</i> <i>Selenkothuria lubrica</i>
Port Utria	5° 59' 10" N 77° 21' 00" W	856-38 Feb. 25, 1938	15-30 fms mud, sand	<i>Selenkothuria lubrica</i>

Locality	Position	Station and date	Depth and bottom	Species collected
Port Utria	5° 59' 10" N 77° 21' 20" W	858-38 Feb. 25, 1938	shore, rock	<i>Selenothuria lubrica</i>
Port Utria	5° 59' 10" N 77° 21' 20" W	859-38 Feb. 25, 1938	shallow water, coral	<i>Brantothuria impatiens</i>
off Port Utria	5° 59' 25" N 77° 21' 50" W	238-34 Feb. 15, 1934	20 fms, sand, shell, cake urchins	<i>Brantothuria impatiens</i>
Port Utria	5° 59' 40" N 77° 21' 30" W	239-34 Feb. 15, 1934	shore, reef inside outer island	<i>Brantothuria arenicola</i> <i>Brantothuria impatiens</i> <i>Brantothuria gyrfifer</i>
Port Utria	5° 59' 55" N 77° 20' 30" W	418-35 Jan. 24, 1935	shore, sand	<i>Brantothuria arenicola</i> <i>Brantothuria impatiens</i> <i>Selenothuria lubrica</i>
Cupica Bay	6° 39' 10" N 77° 30' 40" W	427-35 Jan. 26, 1935	shore, rock	<i>Selenothuria lubrica</i>
Ocravia Bay	6° 49' 50" N 77° 41' 50" W	433-35 Jan. 27, 1935	shore on island, shingle	<i>Brantothuria arenicola</i> <i>Irenothuria maccullochi</i> <i>Selenothuria lubrica</i> <i>Selenothuria portovallartensis</i>
Ocravia Bay	6° 50' 00" N 77° 41' 10" W	435-35 Jan. 28, 1935	shallow water, coral	<i>Brantothuria impatiens</i>
Panama				
Bahia Honda	7° 43' 15" N 81° 32' 40" W	246-34 Feb. 21, 1934	rocky reef	<i>Selenothuria lubrica</i>
Bahia Honda	7° 44' 25" N 81° 32' 45" W	861-38 Mar. 1, 1938	shore, rock	<i>Brantothuria arenicola</i> <i>Brantothuria impatiens</i> <i>Brantothuria gyrfifer</i> <i>Semperothuria languens</i> <i>Irenothuria maccullochi</i> <i>Selenothuria lubrica</i> <i>Fossothuria rigida</i>

Bahia Honda	7° 45' 00" N 81° 31' 40" W	947-39 Mar. 28, 1939	shore, sand, rock	<i>Semperothuria languens</i>
Secas Islands	7° 57' 00" N 82° 01' 25" W	446b-35 Feb. 4, 1935	shore, rock	<i>Lessonothuria pardalis</i> <i>Fossothuria rigida</i> f. <i>atypica</i>
Secas Islands	7° 57' 10" N 82° 00' 45" W	447-35 Feb. 4, 1935	shallow water, coral	<i>Microthele difficilis</i> <i>Brandothuria impatiens</i> <i>Semperothuria imitans</i>
Secas Islands	7° 57' 10" N 82° 00' 45" W	454-35 Feb. 6, 1935	shore, tide flats, coral	<i>Microthele difficilis</i> <i>Brandothuria impatiens</i> <i>Lessonothuria pardalis</i>
Secas Islands	7° 57' 10" N 82° 00' 45" W	867-38 Mar. 2, 1938	shallow water, coral	<i>Microthele difficilis</i> <i>Brandothuria impatiens</i> <i>Lessonothuria pardalis</i>
Taboga Island	8° 47' 35" N 79° 33' 15" W	957-39 May 2, 1939	shore, rock, tide pools	<i>Semperothuria imitans</i> <i>Ludwigiothuria kefersteini</i> <i>Semperothuria languens</i>
Panama City	8° 57' 15" N 79° 31' 45" W	445-35 Feb. 2, 1935	shore, rock	<i>Semperothuria languens</i> <i>Ludwigiothuria kefersteini</i> <i>Selenkothuria lubrica</i>
Costa Rica				
Near South Viradores Islands, Port Culebra	10° 34' 30" N 85° 42' 50" W	258-34 Feb. 25, 1934	shallow water, coral	<i>Brandothuria impatiens</i>
Off South Viradores Islands, Port Culebra	10° 35' 00" N 85° 45' 15" W	257-34 Feb. 25, 1934	10 fms, sand, shells	<i>Microthele difficilis</i>
S of Mala Point, Port Culebra	10° 36' 30" N 85° 42' 15" W	256-34 Feb. 24, 1934	shore, rock	<i>Microthele difficilis</i> <i>Brandothuria impatiens</i> <i>Irenothuria maccullochi</i> <i>Selenkothuria lubrica</i> <i>Brandothuria impatiens</i>
Port Parker	10° 54' 55" N 85° 49' 00" W	473-35 Feb. 9, 1935	shallow water, coral	<i>Brandothuria impatiens</i>
Port Parker	10° 56' 00" N 85° 48' 47" W	466-35 Feb. 9, 1935	shore, small island at entrance, rock	<i>Brandothuria arenicola</i> <i>Selenkothuria lubrica</i>

Locality	Position	Station and date	Depth and bottom	Species collected
Playa Blanca	10° 56' 45" N	465-35	shore, shale	<i>Brandtothuria arenicola</i>
	85° 53' 30" W	Feb. 8, 1935		<i>Brandtothuria impatiens</i> <i>Semperothuria languens</i> <i>Ludwigiothuria kefersteini</i> <i>Fossilithuria rigida</i> f. <i>atypica</i> <i>Selenkothuria lubrica</i> <i>Selenkothuria portovallartensis</i>
Salinas Bay	11° 02' 00" N	474-35	shore, sandstone	<i>Brandtothuria gyryifer</i>
	85° 42' 45" W	Feb. 10, 1935		<i>Selenkothuria lubrica</i> <i>Selenkothuria portovallartensis</i>
Mexico Tangola Tangola Bay	15° 45' 37" N	260-34	shore on small island in bay, rock	<i>Brandtothuria gyryifer</i>
	96° 05' 24" W	Mar. 1, 1934		<i>Selenkothuria lubrica</i>
Tangola Tangola Bay	15° 45' 37" N	261-34	shallow water, coral	<i>Selenkothuria lubrica</i>
	96° 05' 24" W	Mar. 1, 1934		<i>Selenkothuria portovallartensis</i> <i>Ludwigiothuria kefersteini</i>
Roqueta or Grifo Island, off Acapulco Harbor	16° 49' 19" N	2592-54	0-1 fms, sand, rock	<i>Ludwigiothuria kefersteini</i>
	99° 00' 30" W	Jan. 30, 1954		<i>Semperothuria imitans</i> <i>Brandtothuria impatiens</i>
Santa Lucía Bay, Acapulco	16° 50' 54" N	1561-46	1-4 fms, rock, mud, sand	<i>Brandtothuria impatiens</i>
	99° 55' 18" W	Sept. 13, 1946		<i>Brandtothuria impatiens</i> <i>Brandtothuria gyryifer</i> <i>Selenkothuria lubrica</i>
Petatlan Bay	17° 31' 30" N	270-34	shore, rock	<i>Lessonothuria pardalis</i>
	101° 27' 15" W	Mar. 3, 1934		<i>Semperothuria languens</i> <i>Semperothuria languens</i> <i>Selenkothuria lubrica</i>
S of islands off Navidad Head, Tenacatita	19° 12' 50" N	274-34	50 fms mud, sand	<i>Microthole difficilis</i>
	104° 50' 50" W	Mar. 4, 1934		<i>Brandtothuria impatiens</i> <i>Brandtothuria gyryifer</i>
Tenacatita Bay	19° 17' 55" N	2-33	shore of lagoon, loose rock, sand	<i>Mertensiothuria leucopilota</i>
	104° 49' 30" W	Jan. 3, 1933		<i>Semperothuria languens</i> <i>Selenkothuria lubrica</i>
Cleopha Island, Tres Marias Islands	21° 17' 38" N	2601-54		<i>Selenkothuria lubrica</i>
	106° 15' 10" W	Feb. 7, 1954		

Magdalena Island, Tres Marias Islands	21° 26' 00" N 106° 23' 20" W	972-39 May 9, 1939	shore, rock	<i>Isostichopus fuscus</i>
				<i>Brandothuria arenicola</i>
				<i>Brandothuria gyryfer</i>
				<i>Semperothuria languens</i>
Isabel Island	21° 51' 30" N 105° 33' 35" W	749-37 Apr. 3, 1937	rocky reef, low tide	<i>Selenkothuria lubrica</i>
				<i>Brandothuria arenicola</i>
				<i>Brandothuria impatiens</i>
				<i>Brandothuria gyryfer</i>
Isabel Island	21° 51' 30" N 105° 53' 35" W	278-34 Mar. 5, 1934	shore in cove, sand, rock	<i>Semperothuria imitans</i>
				<i>Selenkothuria lubrica</i>
				<i>Isostichopus fuscus</i>
				<i>Brandothuria impatiens</i>
Isabel Island	21° 52' 20" N 105° 53' 40" W	2588-54 Jan. 26, 1954	0-3 fms, rock	<i>Brandothuria gyryfer</i>
				<i>Ludwigothuria kefersteini</i>
				<i>Selenkothuria lubrica</i>
				<i>Ludwigothuria kefersteini</i>
Isabel Island	21° 54' 10" N 105° 58' 15" W	870-38 Mar. 8, 1938	10-15 fms, coralline, gorgonids	<i>Selenkothuria lubrica</i>
				<i>Ludwigothuria kefersteini</i>
				<i>Brandothuria arenicola</i>
				<i>Semperothuria languens</i>
Gulf of California NE of Cape San Lucas	22° 53' 14" N 109° 51' 50" W	1724-49 Mar. 11, 1949	10 fms, sand, shell	<i>Ludwigothuria kefersteini</i>
				<i>Selenkothuria portosallartensis</i>
				<i>Fossothuria rigida</i> f. <i>atypica</i>
				<i>Theelothuria paraprinceps</i>
Cabeza Ballena	22° 53' 20" N 109° 50' 20" W	623-37 Mar. 4, 1937	shore, rock, tide pools	<i>Selenkothuria lubrica</i>
				<i>Microthele difficilis</i>
				<i>Brandothuria impatiens</i>
				<i>Brandothuria gyryfer</i>
NE of Cabeza Ballena	22° 54' 23" N 109° 50' 09" W	1727-49 Mar. 11, 1949	shore, granitic reef	<i>Selenkothuria lubrica</i>
				<i>Ludwigothuria kefersteini</i>
				<i>Brandothuria impatiens</i>
				<i>Brandothuria gyryfer</i>
N of Palmilla Point	23° 00' 30" N 109° 42' 55" W	1730-49 Mar. 12, 1949	shore, sand	<i>Ludwigothuria kefersteini</i>
				<i>Brandothuria gyryfer</i>

Locality	Position	Station and date	Depth and bottom	Species collected
Los Frailes Bay	23° 22' 45" N 109° 24' 37" W	1734-49 Mar. 13, 1949	shore, rocky beach, tide pools	<i>Microthele difficilis</i> <i>Brandtothuria impatiens</i> <i>Semperothuria languens</i> <i>Vaneyothuria zacae</i>
Boco de la Trinidad	23° 38' 00" N 109° 28' 22" W	1037-40 Jan. 21, 1940	150 fms, sand, coralline	<i>Mertensiothuria fuscocinerea</i>
San Lorenzo Channel	24° 21' 55" N 110° 18' 40" W	639-37 Mar. 7, 1937	3-5 fms, sand, coralline, algae	<i>Mertensiothuria fuscocinerea</i>
San Lorenzo Channel	24° 21' 55" N 110° 15' 15" W	1111-40 Feb. 14, 1940	6-13 fms, sand, shell, coralline	<i>Mertensiothuria fuscocinerea</i>
Espiritu Santo Island	24° 25' 15" N 110° 21' 10" W	20 Feb. 17-20, 1932	shore	<i>Mertensiothuria fuscocinerea</i>
San Gabriel Bay, Espiritu Santo Island	24° 25' 25" N 110° 20' 55" W	604-36 Mar. 20, 1936	shallow water, coral	<i>Brandtothuria arenicola</i> <i>Semperothuria imitans</i>
San Gabriel Bay, Espiritu Santo Island	24° 25' 25" N 110° 20' 55" W	500-36 Feb. 20, 1936	shore, sand, rock	<i>Selenkothuria lubrica</i>
San Gabriel Bay, Espiritu Santo Island	24° 25' 25" N 110° 20' 55" W	501-36 Feb. 20, 1936	shallow water, coral	<i>Microthele difficilis</i> <i>Brandtothuria impatiens</i> <i>Semperothuria imitans</i>
San Gabriel Bay, Espiritu Santo Island	24° 25' 25" N 110° 20' 55" W	634-37 Mar. 6, 1937	shallow water, coral	<i>Brandtothuria arenicola</i> <i>Brandtothuria impatiens</i> <i>Selenkothuria lubrica</i>
San Gabriel Bay, Espiritu Santo Island	24° 25' 25" N 110° 20' 55" W	638-37 Mar. 7, 1937	shallow water, coral	<i>Brandtothuria arenicola</i> <i>Brandtothuria impatiens</i> <i>Mertensiothuria fuscocinerea</i> <i>Fossothuria rigida</i> f. <i>atypica</i>
San Gabriel Bay, Espiritu Santo Island	24° 25' 25" N 110° 20' 55" W	1108-40 Feb. 13, 1940	shore, shingle	<i>Brandtothuria arenicola</i> <i>Brandtothuria impatiens</i> <i>Mertensiothuria fuscocinerea</i> <i>Semperothuria imitans</i> <i>Selenkothuria lubrica</i>

San Gabriel Bay, Espiritu Santo Island	24° 25' 25" N 110° 20' 55" W	1109-40 Feb. 14, 1940	1/2-2 fms dipnetting	<i>Mertensiothuria fuscocinerea</i> <i>Ludwigiothuria kefersteini</i>
San Gabriel Bay, Espiritu Santo Island	24° 25' 25" N 110° 20' 55" W	1110-40 Feb. 14, 1940	shoal, coral	<i>Microthele difficilis</i> <i>Brandiothuria imipatiens</i> <i>Semperiothuria imitans</i> <i>Selenkiothuria lubrica</i>
San Gabriel Bay, Espiritu Santo Island	24° 25' 25" N 110° 20' 55" W	1112-40 Feb. 14, 1940	shore, shingle, tide pools at stone pits	<i>Brandiothuria arenicola</i> <i>Brandiothuria imipatiens</i> <i>Semperiothuria imitans</i> <i>Selenkiothuria lubrica</i>
Cove S of Ballenas Bay, Espiritu Santo Island	24° 26' 35" N 110° 22' 00" W	510-36 Feb. 22, 1936	shore, sand, rocks	<i>Isostichopus fuscus</i> <i>Brandiothuria arenicola</i> <i>Brandiothuria imipatiens</i> <i>Irenothuria maccullochi</i> <i>Selenkiothuria lubrica</i>
Ballenas Bay, Espiritu Santo Island	24° 27' 45" N 110° 22' 00" W	512-36 Feb. 23, 1936	shore, rocks	<i>Isostichopus fuscus</i> <i>Labiodemas americanum</i> <i>Brandiothuria arenicola</i> <i>Brandiothuria imipatiens</i> <i>Selenkiothuria lubrica</i>
E of San Francisco Island	24° 49' 50" N 110° 34' 00" W	515-36 Feb. 24, 1936	shore, reef	<i>Selenkiothuria lubrica</i>
San Francisco Island	24° 49' 50" N 110° 34' 00" W	646-37 Mar. 8, 1937	shore, shingle	<i>Brandiothuria imipatiens</i> <i>Semperiothuria imitans</i>
San Francisco Island	24° 49' 50" N 110° 34' 00" W	652-37 Mar. 9, 1937	shore, shingle	<i>Brandiothuria arenicola</i> <i>Brandiothuria imipatiens</i>
Agua Verde Bay	25° 29' 40" N 110° 58' 45" W	522-36 Feb. 27, 1936	shore, reef	<i>Brandiothuria imipatiens</i> <i>Selenkiothuria lubrica</i>
Agua Verde Bay	25° 29' 40" N 110° 58' 45" W	664-37 Mar. 11, 1937	low tide, San Marcial Reef	<i>Brandiothuria imipatiens</i> <i>Semperiothuria imitans</i> <i>Selenkiothuria lubrica</i>
Agua Verde Bay	25° 30' 45" N 111° 04' 11" W	1744-49 Mar. 17, 1949	shore, rocky beach	<i>Brandiothuria imipatiens</i> <i>Selenkiothuria lubrica</i>

Locality	Position	Station and date	Depth and bottom	Species collected
Agua Verde Bay	25° 31' 05" N 111° 02' 30" W	660-37 Mar. 10, 1937	shore, north cove, rock	<i>Isostichopus fuscus</i>
Agua Verde Bay	25° 31' 05" N 111° 02' 30" W	1104-40 Feb. 12, 1940	shore, rock	<i>Brantothuria arenicola</i> <i>Brantothuria impatiens</i> <i>Selenkothuria lubrica</i>
Puerto Escondido	25° 48' 45" N 111° 18' 51" W	1752-49 Mar. 20, 1949	shore, rocky beach	<i>Brantothuria arenicola</i> <i>Brantothuria impatiens</i> <i>Semperothuria imitans</i> <i>Selenkothuria lubrica</i>
Puerto Escondido	25° 48' 04" N 111° 18' 53" W	1749-49 Mar. 18, 1949	rocky shore	<i>Brantothuria impatiens</i> <i>Brantothuria gyrifer</i> <i>Semperothuria imitans</i> <i>Selenkothuria lubrica</i>
Puerto Escondido	25° 48' 47" N 111° 18' 51" W	1774-49 Mar. 28, 1949	shore, rocky beach	<i>Brantothuria arenicola</i> <i>Brantothuria impatiens</i> <i>Selenkothuria lubrica</i>
Puerto Escondido	25° 49' 25" N 111° 18' 35" W	1093-40 Feb. 10, 1940	8-15 fms, sand, sponge, coral	<i>Mertensiothuria fuscocinerea</i>
Puerto Escondido	25° 50' 05" N 111° 19' 00" W	670-37 Mar. 12, 1937	Shore, lagoon entrance, mud	<i>Brantothuria arenicola</i>
Puerto Escondido	25° 50' 05" N 111° 19' 00" W	591-36 Mar. 16, 1936	shore, shingle	<i>Isostichopus fuscus</i> <i>Brantothuria impatiens</i> <i>Semperothuria imitans</i> <i>Ludwigiothuria kefersteini</i> <i>Selenkothuria lubrica</i>
Puerto Escondido	25° 50' 05" N 111° 19' 00" W	1094-40 Feb. 10, 1940	shore, mouth of lagoon, rock	<i>Brantothuria impatiens</i> <i>Selenkothuria lubrica</i>
Puerto Escondido	25° 50' 05" N 111° 19' 00" W	1095-40 Feb. 11, 1940	1-2 fms dipnetting	<i>Mertensiothuria fuscocinerea</i>
Puerto Escondido	25° 50' 05" N 111° 19' 00" W	598-36 Mar. 17, 1936	dipnet and beach	<i>Mertensiothuria fuscocinerea</i>

Puerto Escondido	25° 50' 05" N 111° 19' 00" W	670-37 Mar. 12, 1937	shore, lagoon entrance	<i>Brantothuria arenicola</i> <i>Brantothuria imphatiens</i> <i>Semperothuria imitans</i> <i>Selenkothuria lubrica</i>
Perico Point, Carmen Island	25° 57' 48" N 111° 05' 09" W	1757-49 Mar. 21, 1949	shore, rocky beach	<i>Brantothuria arenicola</i> <i>Selenkothuria lubrica</i> <i>Fossothuria rigida</i> f. <i>atypica</i>
W side of Bargo Island	26° 42' 17" N 111° 53' 33" W	1772-49 Mar. 27, 1949	shore, rocky beach	<i>Brantothuria arenicola</i> <i>Selenkothuria lubrica</i>
Coyote Bay, Concepcion Bay	26° 44' 40" N 111° 54' 00" W	689-37 Mar. 16, 1937	shore, sand, rock	<i>Selenkothuria lubrica</i> <i>Theelothuria para princeps</i>
Aguja Point, Concepcion Bay	26° 51' 30" N 111° 52' 08" W	1769-49 Mar. 26, 1949	shore, tide pools	<i>Isostichopus fuscus</i> <i>Brantothuria arenicola</i> <i>Brantothuria imphatiens</i> <i>Selenkothuria lubrica</i>
N of Cabo Arco, Ensenada Carrizal	26° 42' 17" N 111° 53' 33" W	1513-46 May 15, 1946	shore, reef	<i>Isostichopus fuscus</i>
Bahia Catalina, off Guaymas, Sonora	27° 51' 50" N 111° 06' 15" W	1092-40 Feb. 9, 1940	shore, shingle	<i>Isostichopus fuscus</i> <i>Brantothuria arenicola</i> <i>Brantothuria imphatiens</i> <i>Selenkothuria lubrica</i>
Guaymas Bay, Sonora	27° 54' 28" N 110° 54' 18" W	1041-40 Jan. 23, 1940	shore, shingle	<i>Brantothuria arenicola</i> <i>Brantothuria imphatiens</i> <i>Selenkothuria lubrica</i> <i>Fossothuria rigida</i>
Ensenada Bocoibampo, Guaymas	27° 55' 08" N 110° 50' 43" W	1514-46 May 16, 1946	rocky shore	<i>Selenkothuria lubrica</i>
Ensenada Bocoibampo, Guaymas	27° 55' 08" N 110° 50' 43" W	1515-46 May 16, 1946	mud flats, sandy estuary	<i>Selenkothuria lubrica</i>
Ensenada de San Francisco, Guaymas	27° 55' 08" N 110° 50' 50" W	1516-46 May 17, 1946	reefs, pools	<i>Selenkothuria lubrica</i>
Ensenada de San Francisco, Guaymas	27° 55' 08" N 110° 50' 50" W	1517-46 May 18, 1946	reefs, pools	<i>Brantothuria arenicola</i> <i>Brantothuria imphatiens</i> <i>Selenkothuria lubrica</i>

Locality	Position	Station and date	Depth and bottom	Species collected
Vicinity of Puerto San Carlos, Guaymas	27° 56' 00" N 111° 05' 12" W	1767-49 Mar. 24, 1949	shore, rocky beach	<i>Brandtothuria impatiens</i> <i>Semprothuria imitans</i> <i>Selenkothuria lubrica</i>
Puerto San Carlos, Guaymas	27° 56' 52" N 111° 05' 11" W	1766-49 Mar. 24, 1949	shore	<i>Brandtothuria impatiens</i>
Vicinity of Puerto San Carlos, Guaymas	27° 57' 00" N 111° 04' 00" W	1765-49 Mar. 24, 1949	1 fm	<i>Brandtothuria impatiens</i>
Ensenada de San Francisco, Guaymas	27° 57' 05" N 111° 03' 20" W	739-37 Mar. 30, 1937	shore, shingle	<i>Selenkothuria lubrica</i> <i>Selenkothuria theeli</i>
Puerto San Carlos, Guaymas	27° 57' 15" N 111° 04' 45" W	1091-40 Feb. 8, 1940	shore, shingle	<i>Isostichopus fuscus</i> <i>Brandtothuria impatiens</i> <i>Selenkothuria lubrica</i> <i>Fossothuria rigida</i>
San Pedro Nolasco Island	27° 58' 35" N 111° 22' 40" W	1084-40 Feb. 6, 1940	93-111 fms, rocks	<i>Jaegerothuria inhabilis</i>
N of San Pedro Nolasco Island	27° 58' 40" N 111° 24' 10" W	573-36 Mar. 12, 1936	60 fms rock, sand	<i>Vaneyothuria zacae</i> f. <i>typica</i>
San Francisco Bay	28° 26' 40" N 112° 52' 40" W	533-35 Mar. 2, 1936	40 fms, sand, broken shell	<i>Vaneyothuria zacae</i> f. <i>typica</i>
San Esteban Island	28° 39' 40" N 112° 35' 35" W	1083-40 Feb. 5, 1940	shore, rock	<i>Brandtothuria impatiens</i> <i>Selenkothuria lubrica</i>
S shore of Tiburon Island	28° 45' 35" N 112° 17' 45" W	1045-40 Jan. 25, 1940	shore, shingle	<i>Isostichopus fuscus</i> <i>Brandtothuria impatiens</i> <i>Selenkothuria lubrica</i> <i>Jaegerothuria inhabilis</i>
S of Isla Partida	28° 51' 20" N 113° 03' 45" W	559-36 Mar. 9, 1936	45 fms, sand	<i>Brandtothuria arenicola</i> <i>Brandtothuria impatiens</i> <i>Selenkothuria lubrica</i>
Angeles Bay	28° 53' 40" N 113° 32' 45" W	537-36 Mar. 2, 1936	shore, sand	<i>Brandtothuria impatiens</i> <i>Selenkothuria lubrica</i>
Angeles Bay	28° 53' 40" N 113° 32' 45" W	700-37 Mar. 19, 1937	shore, shingle	<i>Brandtothuria impatiens</i> <i>Selenkothuria lubrica</i>

Between Isla Partida and Angel de la Guarda Island	28° 56' 50" N 113° 07' 00" W	555-36 Mar. 8, 1936	20 fms, nullipores	<i>Jaegerothuria inhabilis</i>
Entrance to Angeles Bay	28° 57' 00" N 113° 30' 45" W	535-36 Mar. 2, 1936	25-40 fms, sand	<i>Vaneothuria zacae</i> f. <i>typica</i>
Entrance to Angeles Bay	28° 57' 00" N 113° 30' 45" W	538-36 Mar. 3, 1936	25 fms, sand	<i>Vaneothuria zacae</i> f. <i>typica</i>
Angeles Channel	28° 57' 35" N 113° 29' 30" W	699-37 Mar. 19, 1937	30 fms, sand	<i>Vaneothuria zacae</i> f. <i>typica</i>
E of Angel de la Guarda Island	29° 01' 00" N 113° 12' 15" W	554-36 Mar. 8, 1936	10 fms, sand, red algae, scallops	<i>Vaneothuria zacae</i> f. <i>typica</i>
Pond Island, Angel de la Guarda Island	29° 02' 35" N 113° 07' 40" W	1079-40 Feb. 4, 1940	shore, rocks	<i>Brandiothuria arenicola</i> <i>Brandiothuria impatiens</i>
Puerto Refugio, Angel de la Guarda Island	29° 32' 07" N 113° 34' 12" W	545-36 Mar. 4, 1936	shore, rocks	<i>Vaneothuria zacae</i> f. <i>typica</i> (beachworn)
Puerto Refugio, Angel de la Guarda Island	29° 32' 47" N 113° 34' 47" W	707-37 Mar. 20, 1937	shore, rock	<i>Brandiothuria arenicola</i> <i>Brandiothuria impatiens</i> <i>Selenkothuria lubrica</i>
Puerto Refugio, Angel de la Guarda Island	29° 32' 47" N 113° 34' 35" W	713-37 Mar. 21, 1937	shore, rock	<i>Selenkothuria lubrica</i>
Puerto Refugio, Angel de la Guarda Island	29° 32' 47" N 113° 34' 35" W	1049-40 Jan. 27, 1940	shore, rocky reef	<i>Brandiothuria impatiens</i> <i>Selenkothuria lubrica</i>
Puerto Refugio, Angel de la Guarda Island	29° 32' 47" N 113° 34' 35" W	1053-40 Jan. 28, 1940	shore, rock	<i>Brandiothuria arenicola</i> <i>Brandiothuria impatiens</i>
Puerto Refugio, Angel de la Guarda Island	29° 33' 45" N 113° 32' 24" W	711-37 Mar. 21, 1937	40 fms, sand	<i>Jaegerothuria inhabilis</i> <i>Vaneothuria zacae</i> f. <i>typica</i>
Off Puerto Refugio	29° 33' 45" N 113° 30' 32" W	1057-40 Jan. 29, 1940	51-56 fms sandy gravel	<i>Vaneothuria zacae</i> f. <i>typica</i>
Puerto Refugio, Angel de la Guarda Island	29° 34' 25" N 113° 32' 35" W	708-37 Mar. 21, 1937	60 fms, sand	<i>Vaneothuria zacae</i> f. <i>typica</i>
Puerto Refugio, Angel de la Guarda Island	29° 34' 25" N 113° 32' 35" W	541-36 Mar. 4, 1936	60 fms broken shell	<i>Vaneothuria zacae</i> f. <i>typica</i>

Locality	Position	Station and date	Depth and bottom	Species collected
Puerto Refugio, Angel de la Guarda Island	29° 34' 35" N	712-37	50-75 fms, sand	<i>Vaneyothuria zacae</i> f. <i>typica</i>
	113° 29' 30" W	Mar. 21, 1937		
N of Granite Island, Angel de la Guarda Island	29° 34' 50" N	1055-40	57 fms, shells, cake urchins	<i>Vaneyothuria zacae</i> f. <i>typica</i>
	113° 33' 45" W	Jan. 28, 1940	shore, shingle	<i>Brantothuria arenicola</i> <i>Brantothuria impatiens</i> <i>Selenkothuria lubrica</i>
Willard Island, Gonzaga Bay	29° 48' 25" N	1063-40		<i>Selenkothuria lubrica</i>
	114° 23' 30" W	Jan. 30, 1940	shore, rock, reef	
Tepoca Bay	30° 15' 45" N	1076-40		<i>Isostichopus fuscus</i>
	112° 53' 20" W	Feb. 3, 1940	shore, rock, reef	<i>Brantothuria arenicola</i> <i>Brantothuria impatiens</i> <i>Selenkothuria lubrica</i>
Tepoca Bay	30° 15' 45" N	1077-40		<i>Selenkothuria lubrica</i>
	112° 53' 20" W	Feb. 4, 1940	shore, rock	
Georges Island	31° 00' 40" N	723-37		<i>Fossothuria rigida</i>
	113° 16' 05" W	Mar. 25, 1937	shore, sand and rock	<i>Brantothuria impatiens</i> <i>Selenkothuria lubrica</i> <i>Selenkothuria lubrica</i>
West coast of Lower California	24° 29' 24" N	1719-49		
	111° 50' 26" W	Mar. 9, 1949	shore, rocky beach	
E shore of Santa Margarita Island	24° 30' 30" N	1713-49		
	112° 00' 51" W	Mar. 8, 1949	shore, rock	
Entrada Point, Magdalena Bay	26° 15' 00" N	1960-50		
	112° 28' 45" W	May 1, 1950	shore, elephant seal beach	
San Juanico Bay, inside Punta Pequeña	27° 06' 00" N	758-37		
	118° 15' 00" W	July 18, 1937	shore, rock, reef, tide pools	
Guadalupe Island	27° 49' 00" N	2022-51		
	114° 43' 00" W	Apr. 17, 1951	shore, reef, tide pools	
W of Malarrimo Point	27° 49' 00" N	2025-51		
	114° 43' 00" W	Apr. 18, 1951	shore, reef, tide pools	

Nameless Cove, E. of Punta Eugenia	27° 50' 00" N 114° 51' 30" W	2064-51 Oct. 31, 1951	shore, rock, shingle	<i>Brandtothuria impatiens</i> <i>Selenkothuria lubrica</i>
Lagoon Head Anchorage	28° 12' 25" N 114° 06' 30" W	612-37 Mar. 1, 1937	7 fms, sand	<i>Isostichopus fuscus</i>
Cove S of Cedros Island Light	28° 20' 56" N 115° 11' 23" W	1696-49 Mar. 4, 1949	10-20 fms, sand, broken shell	<i>Vaneyothuria zacae f. iota</i>
Melpomene Cove, Guadalupe	28° 51' 03" N 118° 17' 43" W	1920-49 Dec. 19, 1949	50-51 fms, sand	<i>Vaneyothuria zacae f. iota</i>
Melpomene Cove, Guadalupe	28° 55' 33" N 118° 18' 38" W	1919-49 Dec. 19, 1949	34-36 fms, sand	<i>Vaneyothuria zacae f. iota</i>
Off Rosario Bay	29° 53' 45" N 115° 49' 30" W	611-37 Feb. 28, 1937	25 fms, rock	<i>Brandtothuria impatiens</i>

SYSTEMATIC ARRANGEMENT

I had hoped to include a complete revision of all the tropical shallow water aspidochirotetes, of which the Museum of Comparative Zoology possesses an unequalled series, but this was not found practical. Like every worker who studies these forms, I am greatly indebted to Panning's revision of the genus *Holothuria*. But this magnificent work suffers from his dependence in too many cases on the accounts of earlier writers; hence many errors have been perpetuated and related forms have been placed far apart. I would have preferred to follow his arrangement, but this has not always been possible. Where his groups have been well defined, as in his concept of Brandt's *Microthele*, I have used them. In other cases, as in his use of the name *Sporadipus*, I have had to take another course, and the best solution seemed to be to split up the old genus *Holothuria* into a series of new genera. As far as possible I have used the old ending *-othuria* with a suitable prefix, resulting in names like *Selenkothuria*, *Thelothuria*, *Mertensiothuria*, etc., which should not be too difficult to apply.

Many attempts have been made to arrange the numerous species in the old genus *Holothuria* in a reasonable systematic order, and the key which is given here for the genera known from the Panamic region should make it clear how the lines have been drawn.

The members of this group are essentially adapted to live either free on the bottom of lagoons, or buried in sand or mud, or clinging to rocks, often exposed to the surf. Within each habitat are groups in different stages of development, which can be separated by means of their spicules. Most primitive are undoubtedly those with numerous regular tables and regular smooth buttons, somewhat reminiscent of certain synallactidlike members of the Stichopodidae. A more advanced stage is indicated by the presence of irregular buttons, or the development of rosettes, or the reduction of the inner layer of spicules, while the tables have become variously modified. In the surf-loving forms, one group has a well developed layer of tables, another section has them reduced almost completely, and in some species there are only a few rods in the inner layer. Among the burrowing forms, some are more or less cylindrical in body form while others are flattened, and the spicules vary from regular tables and buttons, to hemispherical tables and regularly knobbed buttons, to reduced tables and irregularly knobbed, deformed buttons, etc. There is nothing essentially new in the present arrange-

ment and much of what is presented here is more or less foreshadowed in the key which W. K. Fisher made for the Hawaiian holothurians in 1907.

AFFINITIES TO OTHER REGIONS

The aspidochirote shallow water forms may be grouped roughly as follows: Two species are almost circumtropical, *Brandtothuria arenicola* and *B. impatiens*, while six appear to be offshoots from the west Pacific and from their sparse occurrence may be considered more or less casual visitors in the Panamic region: *Ludwigothuria atra*, *Mertensiothuria fuscocinerea*, *Brandtothuria gyrifer*, *Semperothuria imitans*, *Mertensiothuria leucospilota*, and *Lessonothuria pardalis*. Four species are closely related to West Indian forms and apparently do not occur outside the Panamic region: *Isostichopus fuscus*, *Ludwigothuria kefersteini*, *Semperothuria languens*, and *Selenkothuria lubrica*, with the corresponding forms in the West Indies: *Isostichopus badionotus*, *Ludwigothuria grisea*, *Semperothuria surinamensis*, and *Selenkothuria glaberrima*.

Another group is widespread in the Indo-West Pacific region and has more or less closely related counterparts in the West Indies: *Microthele difficilis*, *Jaegerothuria inhabilis*, *Theelothuria paraprinceps*, *Fossothuria rigida*, and *Vaneyothuria zacae*, with the corresponding West Indian forms *Microthele parvula*, *Jaegerothuria occidentalis*, *Theelothuria princeps*, *Fossothuria cubana*, and *Vaneyothuria lentiginosa*. *Theelothuria paraprinceps* in all probability will be found to be identical with some older species from the East Indies, while *Vaneyothuria zacae* may be withdrawn as a synonym of some such form as *V. integra* or *V. neozelanica*.

Apparently endemic to the Panamic region are *Labidodemas americanum*, *Irenothuria maccullochi*, *Selenkothuria portovallartensis*, and *S. theeli*, to which it seems proper to add *Mertensiothuria platei*, from Juan Fernandez, as it may possibly extend into the southernmost part of the Panamic region and is not known from outside the American waters.

Aside from *Isostichopus*, the total absence of such large lagoon forms as the members of the genera *Actinopyga*, *Bohadschia*, *Astichopus*, etc., is noteworthy.

Compared with Hawaii and the West Indies, using Fisher's and Deichmann's papers, the supposedly barren shores of the Panamic region have more aspidochirote forms than either. About one third of the fauna

consists of species which have been able to cross Ekman's "barrier," another third is most closely related to the West Indian fauna, and the rest are either endemic or closely related to widespread Indo-Pacific forms. Future explorations may modify these statements somewhat. More species may be found in Hawaii, as well as in the Gulf of Mexico; some of the species described as special to Hawaii may be withdrawn as synonyms, etc.; but as a whole the present picture will not be altered much and there seems no great likelihood that many more species will be added to the Panamic fauna.

ASPIDOCHIROTA

(from shallow water)

KEY TO THE FAMILIES OF SHALLOW WATER ASPIDOCHIROTA

- Gonads in two tufts. Large forms, often with thickened flanks, cylindrical feet in crowded bands on the ventrum, and large warts on the dorsum. Spicules a crowded to reduced layer of tables and often delicate, C-shaped bodies, or as minute grains. Smooth buttons in some genera. I. Stichopodidae
- Gonads in single tuft. Small to large forms; flanks not thickened. Spicules variously developed, never as delicate, C-shaped bodies. II. Holothuriidae

I. Stichopodidae

Diagnosis: Large primitive aspidochirotetes, with gonads in two tufts, tentacle ampillae, and well developed respiratory trees. Exterior more or less synallactidlike. Except for one doubtful genus (*Astichopus*), ventral feet large, in more or less crowded bands, dorsal side with papillae, simple or complex, few to many. Large ventral tentacles and terminal anus. Spicules in most genera tables, and in addition either smooth buttons, regular or deformed, delicate rosettes, or C-shaped bodies. In two genera the spicules reduced to minute grains or rods.

Chiefly restricted to tropical shores, with three genera in colder waters or extending to a depth of several hundred fathoms.

Type genus: *Stichopus* Brandt.

Remarks: In 1922 H. L. Clark subdivided the old genus *Stichopus*, and the four genera he accepted have been more or less recognized. In 1948 a new genus was added by Deichmann, and the division is now completed by the addition of two more genera, of which one is char-

acteristic of the Panamic and West Indian region. A key is given to the seven genera to explain the present arrangement.

KEY TO THE GENERA OF THE FAMILY STICHOPODIDAE

- 1. No tables in skin, only minute grains or rods. 2
- 1. Numerous to few tables in the skin. 3
- 2. Dorsal papillae united into complex leaflike structures. East Indian reefs. *Thelenota* Brandt
- 2. Dorsal side with numerous small feet or papillae. West Indies. (Position doubtful) *Astichopus* H. L. Clark
- 3. Synallactidlike forms, cylindrical, with few large papillae on the dorsal side and comparatively few feet in bands on the ventrum. In colder waters or to a depth of several hundred fathoms. 4
- 3. Flanks more or less thickened. 5
- 4. Tables, gradually becoming reduced, and delicate buttons with two lateral and two terminal holes, often reduced to irregular bodies. South African waters. *Neostichopus* Deichmann
- 4. Tables well developed; buttons absent or with several holes along the sides and no terminal holes. North Atlantic, North Pacific, and New Zealand waters. *Parastichopus* H. L. Clark
- 5. Numerous small papillae along side of ventral sole. Tables with large disk with several circles of holes. Atlantic Ocean, in deeper water. *Eostichopus* n. gen.
- 5. Comparatively few large papillae along the side of ventral sole. 6
- 6. Tables with four clusters of few spines on spire; disk mostly with four central and four marginal holes. Often fragile rosettes and C-shaped bodies. Indo-West Pacific tropical shore forms. *Stichopus* Brandt
- 6. Tables with wreath of small spines on spire; disk mostly with circle of many small holes. No delicate rosettes, but C-shaped bodies often present. Shores of the tropical region of the American waters. *Isostichopus* n. gen.

Isostichopus n. gen.

Stichopus auctores (*partim*).

Diagnosis: Large form with thickened flanks and (in the full-grown animal, with a length of about 25 cm) up to 20 blunt lateral

papillae, and a similar number in the dorsal rows. Sole well developed, with three bands of cylindrical feet. Spicules a dense layer of low, squat tables; in the adult, with a circular disk with 8 to 12 small holes, single crossbeam, and a wreath of small spines on the top; C-shaped bodies present in varying numbers and sizes. Feet with large end plate and large supporting plates with numerous holes; smaller curved rods or plates in the dorsal appendages. Dorsal appendages usually lacking end plate. Tropical shores of America.

Type species: Stichopus badionotus Selenka.

KEY TO THE SPECIES OF *Isostichopus*

- Tables taller than wide; profile of tables rectangular. Color variable, from black to orange, often spotted or striped. Common in the West Indies, including Bermuda.
 *badionotus* (Selenka)
- Tables about as wide as tall; profile roughly quadrate. Color uniformly chocolate brown with paler ventral side; young more lightly colored, often with a faint reticulum of darker brown on the dorsum. Tropical west coast of Mexico, Central and South America. *fuscus* (Ludwig)

Isostichopus fuscus (Ludwig)

Pl. 1, figs. 1-3

Stichopus fuscus Ludwig, 1875, p. 97; 1898, p. 5, pl. 1, figs. 1-5.
 H. L. Clark, 1910, p. 350 (not examined); 1922, p. 45 (rejected as unidentifiable). Deichmann, 1937, p. 163; 1938, p. 363. Steinbeck & Ricketts, 1941, p. 410.

Stichopus badionotus Selenka, 1867, p. 316 (*partim*). H. L. Clark, 1922, p. 55 (*partim*).

Non Stichopus fuscus Théel, 1886a, p. 5 (*Parastichopus californicus* (Stimpson), from San Diego, California).

Diagnosis: See diagnosis of genus and key.

Type: Possibly in Germany.

Type locality: "Patagonia," probably wrong. As a substitute one might use Machalilla, Ecuador, from which locality Ludwig reported it in 1898.

Distribution: Common from Ecuador to the upper end of the Gulf of California; also in the Galapagos, Socorro, and Cocos Islands. Not known from the western coast of Lower California or from California.

Depth: From shore to about 20 fathoms.

Specimens examined: Several in various collections in the United States and Europe. A total of 35 collected by the Hancock expeditions from 29 stations.

Remarks: The *Velero III* material has confirmed the correctness of the differences previously listed for the two members of the genus. More important than actual measurements are the proportions of the tables—narrower in the Atlantic species, almost square in side view in the Pacific form.

The *Velero* material, as well as that which Dr. Mortensen brought back from Panama in 1916-1917, ranges in length from a few to about 20 cm; the animals shrink considerably when preserved and for practical reasons one avoids picking up the largest individuals, which are more difficult to preserve before they have time to dissolve into slime. In the young individuals, which are paler in color and have fewer appendages, one finds often larger, more delicate tables, with a tall fragile spire and four central holes surrounded by 4 to 10 smaller ones, similar to those found in *Parastichopus* and *Stichopus* of similar age.

Steinbeck & Ricketts note that the species is extremely common in favorable sheltered localities and say that they could easily have collected fifty individuals in a short time in the lagoon at Puerto Escondido, in the Gulf of California.

II. Holothuriidae

Diagnosis: Aspidochirote holothurians with respiratory trees, *rete mirabile*, well developed tentacle ampillae, and the gonads in a single tuft to the left of the dorsal mesentery. Tentacles 20 to 30, in most species 20; mouth terminal or ventral in position. Shape of body varying from cylindrical to flattened, with appendages in different arrangement and different development, as cylindrical tube feet or more papilliform, with sucking disk reduced or lacking. Spicules diversified, in most forms an outer layer of tables, absent or reduced in some groups; in addition often an inner layer of buttons—regular or irregular, knobbed or smooth—rosettes, rods or plates. With the outer layer of tables lacking or reduced, the inner layer usually well developed (except in some of the surf-loving forms with very few spicules). Tube feet mostly with end plate and a varying number of supporting rods or plates; in the papillae, end plate reduced or lacking and rods, if present, mostly curved and short.

Mostly shallow water forms living in the tropical region, either freely exposed in the lagoon, or concealed among rocks, hidden in sand or mud, or attached to rocks in the surf zone. A few species descending to a depth of 200 to 250 fathoms and some extending into colder waters.

Type genus: "*Holothuria*" Linnaeus 1758.

Remarks: The history of this family is rather exasperating. The original genus *Holothuria* of Linnaeus, listed in the 10th edition with four species, is based on some of the large siphonophores, such as *Physalia*, as was pointed out by T. Gill in Science, 1907, p. 185, in a critical attack on W. K. Fisher. The latter (*ibid.*, p. 389) admitted the correctness of this fact, but posed the question of what to do with a name which has been as well established as the word "mammal," and how to get around the use of the word *Holothurioidea*, etc. Linnaeus' name was at first accepted as the name for all the common tropical aspidochirotcs; but in the course of time the most characteristic forms were segregated under new generic names, and various writers strove to arrange the remaining large number of species in a more or less natural order, using the distribution of the feet, the spicules, and other features. In these efforts they were greatly handicapped by the incompleteness of the earlier descriptions.

In 1914 Pearson attempted to subdivide the large genus *Holothuria* on the basis of his knowledge of a very limited fauna, that of Ceylon. Unfortunately he selected the poorest, most artificial of all systems, that of Brandt, with its many useless generic names—useless because in many cases one cannot recognize the species he describes and in others his definitions are so broad that almost any species could be included in the genus. Pearson's system has more or less been adopted by Heding and Panning. To the latter we are indebted for a most careful revision of the genus *Holothuria*, as well as *Bohadschia* and *Actinopyga*; for some reason he did not include the small genus *Labidodemas*.

Panning included about 120 species in *Holothuria s. l.*, subdivided into smaller groups which unfortunately are not clearly defined. Of these species, about 40 can either be withdrawn as synonyms of well known forms or are so incompletely described that they must be rejected. About 80 species remain. Twenty are here reported from the Panamic region, plus *Mertensiothuria platei*, from Juan Fernandez, which possibly may be found to range into the region under discussion. Two of these species were not included in Panning's report, and one of them is new.

The material discussed here is divided into 13 genera, which take in the majority of the known species. Whenever possible, all the species referred to a genus have been included in the key; in other cases a tentative list is given of the species which probably should be referred to the genus. As for the genus *Holothuria* L., which has no right to exist, one might abandon it completely, using the name as a colloquial term, like "amphioxus," which covers all lancelets; or one might select as its type one of the oldest and best known species from the Mediterranean, such as *Holothuria poli* delle Chiaje, which possibly may have been the form Aristotle had in mind when he gave the first description of these animals.

KEY TO THE GENERA OF THE FAMILY HOLOTHURIIDAE FROM THE PANAMIC REGION

- 1. Skin gelatinous, soft. Appendages restricted to the ambulacra, not numerous. Calcareous ring unusually low and delicate with almost ribbonlike interradialia. Spicules tables, not numerous, and in some species a few buttons, usually twisted and incomplete, suggesting clumsy C-shaped bodies. Color white or golden brown, mostly with darker appendages. 1. *Labidodemas* Selenka
- 1. Skin not gelatinous, soft. If appendages restricted more or less to the ambulacra, the spicules numerous. Calcareous spicules variously developed, rarely with tables completely lacking; and in that case spicules of other forms—rods, buttons—present in the inner layer. 2
- 2. Skin with few to many spicules, never rigid from being packed with spicules. 3
- 2. Skin parchmentlike, stiff, packed with spicules. Burrowing forms. 11
- 3. Tables forming a close outer layer. Disk usually lacking; spire tall, ending in a few strong spines, forming a Maltese cross when seen from above. Inner layer lacking, or consisting of scattered huge, flat bars. Slender form, cylindrical or bottle-shaped, with small terminal tentacles. Under rocks. (*languens* group) 6. *Semperothuria* n. gen.
- 3. Tables variously developed but not forming a crowded outer layer and not lacking the disk. If tables lacking or rare, a deeper layer of rods, buttons or rosettes is developed. . . . 4

- 4. Inner layer consisting of regular smooth buttons. Tables more or less well developed, with disk and small teeth, few to many on the tip of the spire. 5
- 4. Inner layer, if present, not as regular smooth buttons but as rosettes, rods or plates, or partly irregular, more or less twisted buttons. Tables variously developed, lacking in one genus. 6
- 5. Buttons large, thin, with 3 to 5 pairs of small holes. Animals flattened, with numerous ventral feet, large ventral tentacles, and few warts on dorsum. Under rocks. (*difficilis* group) 2. *Microthele* Brandt, Panning emend.
- 5. Buttons small, with three pairs of holes, large to small, even to the point of obliteration. Cylindrical to flask-shaped forms, with small terminal tentacles. Concealed among rocks or in sand. (*arenicola* group) 3. *Brandtothuria* n. gen.
- 6. Tables lacking except as vestiges in young individuals. Spicules spinous to smooth rods, or small plates or curved bars with a varying number of holes. Soft-skinned, with numerous feet on the ventrum and small papillae on dorsum. Tentacles large, often bushy, almost dendritic. Living attached to rocks, often in surf zone. (*lubrica* group) 10. *Selenkothuria* n. gen.
- 6. Tables present, though in some forms rare. 7
- 7. Tables of moderate size or small, with small disk. Spicules in inner layer rosettes or small perforated plates or incomplete buttons. Free living, in lagoons. 8
- 7. Tables large, delicate or robust, either alone or with mostly irregular, twisted buttons. 9
- 8. Tables with small disk, moderate to high spire and 8 to 12 sharp spines on top, eight forming a Maltese cross. Inner layer small rosettes or small perforated plates. (*atra* group) 9. *Ludwigothuria* n. gen.
- 8. Tables low, degenerate, often incomplete. Inner layer as smooth buttons, often incomplete, or as oblong rosettes. (*leucospilota* group) 5. *Mertensiothuria* n. gen.
- 9. Tables alone, numerous, with large disk and four slender rods arising as parallel columns and turning outward at the top; one basal crossbar. Smaller tables with reduced spire in the feet. Slender, cylindrical to flask-shaped, with few feet in scattered rows. (*maccullochi* group) 7. *Irenothuria* n. gen.

9. Tables variously developed, but not with four slender columns curving outward at the top. 10
10. Clumsy tables with low spire and margin of disk often dentate. Buttons regular to irregular, often twisted or incomplete. Small cylindrical forms with small terminal tentacles. Under rocks. (*pardalis* group) . . . 4. *Lessonothuria* n. gen.
10. More or less irregular tables, often with dentate margin and a cluster of irregular sharp spines on top of the spire. Buttons large, often irregular, becoming smaller and more regular with age; buttons lacking in one form. Large cylindrical body with small ventral tentacles and a moderate number of ventral feet, and still fewer papillae on the dorsum and along the flanks. Usually with a pale area around the base of the mostly darker appendages. In deeper water, 50 to 250 fathoms. (*lentiginosa* group) . . . 8. *Vaneyothuria* n. gen.
11. Tables well developed, with knobby margin and spire often transformed into a reticulated mass. Buttons regular, strongly knobbed; longer on the ventrum and may here show a tendency to become less knobby with age. Flattened forms with small ventral tentacles and small feet and papillae. (*rigida* group) 11. *Fossothuria* n. gen.
11. Tables with tendency to become reduced, spire never forming a large reticulated mass. Buttons irregular, often twisted or incomplete, with or without irregularly scattered knobs. 12
12. Stout forms with ventral tentacles and large ventral sole of cylindrical feet, back covered by conical papillae. Calcareous ring stout, of normal shape. (*inhabilis* group)
- 12. *Jaegerothuria* n. gen.
12. Stout form with cylindrical body and small terminal tentacles. Conical appendages dorsally and ventrally, on the ventrum ending in a retractile cylindrical tube foot. Calcareous ring with short posterior prolongations on the radials. (*princeps* group) 13. *Theelothuria* n. gen.

1. *Labidodemas* Selenka 1867

Labidodemas Selenka, 1867, p. 309.

Diagnosis: Medium-sized species, up to 15 cm long, with 20 small tentacles terminally placed, anus subterminal. Feet few, in single to double rows along the radii, rarely spreading out into the interambul-

acra; ventrally cylindrical, dorsally more papilliform. Calcareous ring delicate with very elongate ribbonlike interradialia. Color white to golden brown, mostly with dark appendages and tentacles. Skin soft, thick, gelatinous.

Spicules few, as scattered tables, stout or delicate; in the type species a few buttons present, deformed or incomplete, suggesting clumsy C-shaped bodies.

Type species: Labidodemas semperianum Selenka.

Remarks: Three species previously described were united by Sluiter (1901) under one name. At the same time he established a rather doubtful new species without any spicules. Ludwig's *Holothuria pertinax* (see Panning, 1934, III, p. 75, text-fig. 57) is withdrawn as a synonym of *Labidodemas semperianum*. A new species of *Labidodemas* was described from the Panamic region in 1938.

Labidodemas americanum Deichmann 1938

Pl. 1, fig. 5

Labidodemas americanum Deichmann, 1938, p. 363, text-fig. 1.

Diagnosis: As for the genus, but spicules delicate tables with four central holes, a circle of about ten marginal holes, of which some may be imperfect, and often a few blunt marginal teeth; spire sometimes reduced to four knobs. Large cylindrical feet on the ventrum with a large end plate and a few small plates with 4 or 5 holes, possibly representing reduced tables; the dorsal appendages papilliform and seemingly lacking the end plate completely, but with small plates in the walls, similar to those in the ventral feet.

Color varying shades of golden brown, inclining toward greenish; usually dark brown appendages and tentacles, in some specimens faded.

Type: Museum of Comparative Zoology.

Type locality: Costa Rica, Jasper Island.

Distribution: Known from Galapagos Islands, Cocos Island, Costa Rica, and Espiritu Santo Island, Gulf of California.

Depth: Shore.

Specimens examined: The types and the 13 specimens collected by the Hancock expeditions—Galapagos Islands, 8 specimens from 4 stations; Cocos Island, 2 specimens; Espiritu Santo Island, 3 specimens.

Remarks: The Hancock material ranges in length from 2 to 7 cm and varies somewhat in color; in some specimens the ventral appendages are almost white. The species is well characterized and quite distinct

from the widespread type species described from Hawaii, which has rather stout tables with long spines on the tip of the low spire, and in addition a few deformed buttons. Both the type species and the present form appear to be rather rare, and one has the impression that the genus is a survival of a primitive, synallactidlike type which has been able to hold its own in some parts of the tropical shore region.

2. *Microthele* Brandt 1835

Microthele Brandt, 1835, p. 54. Panning, 1929, I, p. 130 (*partim*).

Mülleria auct. (*partim*).

Actinopyga auct. (*partim*).

Diagnosis: Medium-sized to large forms, with 20 large ventral tentacles and numerous cylindrical feet on the ventral side, the dorsal side with scattered low papillae, often placed on low warts. Anus terminal with calcified papillae; with the skin scraped off, these papillae simulate anal teeth. Cuvierian organs large.

Spicules an external layer of crowded tables with well developed disk having a varying number of holes and round to squarish in outline; spire low, squat, with a single crossbeam and many short spines on the top. An inner layer of large thin buttons, oval or slightly S-shaped, with two rows of comparatively small holes. Ventral feet with large end plate and large plates, more or less symmetrically developed with numerous holes; dorsal appendages with reduced end plate or none, and more simple rods.

Color varying shades of brown, in one form with the papillae surrounded by a pale area. A green fluorescent pigment present in one species (*M. parvula*), possibly in all.

Type species: *Holothuria sanctori* delle Chiaje.

Remarks: The name *Microthele* is accepted in the sense in which Panning used it in 1929, pp. 130-138, with some corrections, in order to avoid an endless reshuffling of names. Brandt's diagnosis, 1835, p. 54 "Dorsi pedes parum evoluti, rarius ex eminentiis mamillosis parum distinctis prominentes," fits the members of the *Holothuria difficilis* group—as well as many others.

Of the nine species which Panning lists, *Holothuria (Microthele) nobilis* (Selenka) (and *Holothuria whitmaei* Bell) must be transferred to another genus; *Holothuria (Microthele) aegyptiana* (Helfer) was based on a poorly developed individual of the *rigida* group. *Holothuria (Microthele) lubrica* (Sluiter), based on two specimens 4.2 cm long,

from Thursday Island, appears to be young individuals of *Mertensiothuria leucospilota* (Brandt). The remaining six species are reduced to three: *Microthele difficilis* (Semper), including *Holothuria excellens* (Ludwig), *H. bedfordi* (Deichmann), and *H. altimensis* H. L. Clark; *Microthele sanctori* (delle Chiaje), with its synonym *Holothuria flavocastanea* (Théel); and *Microthele parvula* (Selenka).

KEY TO THE SPECIES OF THE GENUS *Microthele*
BRANDT, EMEND. PANNING

1. Large species, 20 cm, brown with paler area around the dorsal papillae. Mediterranean, Eastern Atlantic, as far south as St. Helena. *sanctori* (delle Chiaje)
1. Small to medium-sized species. Color uniformly brown or yellow. 2
2. Specimens about 5 cm long, color light brown or yellow. Buttons comparatively narrow, often S-shaped. West Indies, including Bermuda. *parvula* (Selenka)
2. Specimens up to 10 to 12 cm long; color usually dark brown. Buttons broad oval. Indo-Pacific. *difficilis* (Semper)

Microthele difficilis (Semper)

Pl. 1, figs. 6-9

Holothuria difficilis Semper, 1868, p. 92, pl. 30, fig. 21. Panning, 1929, I, p. 136, text-fig. 20 (copied from various authors), complete list of references. Deichmann, 1937, p. 164. Steinbeck & Ricketts, 1941, p. 407.

Mülleria excellens Ludwig, 1875, p. 98, pl. 7, fig. 32.

Holothuria (Microthele) excellens, Panning, 1929, I, p. 132, text-fig. 16 (copied from Ludwig).

Actinopyga bedfordi Deichmann, 1922, p. 212.

Holothuria (Microthele) bedfordi, Panning, 1929, I, p. 136, text-fig. 19 (copied from Bedford).

Holothuria frequentiamensis H. L. Clark, 1902, p. 530. Panning, 1934, III, p. 73.

Holothuria altimensis, H. L. Clark, 1921, p. 172, pl. 37, figs. 20-29. Panning, 1935, IV, p. 94, text-fig. 82 (copied from H. L. Clark).

Diagnosis: Medium-sized form, 10 to 12 cm long, usually dark brown, sometimes almost purplish black, rarely more yellow. Spicules a

crowded layer of tables with about 8 holes in the disk, often with smaller holes intercalated between them; spire low with numerous spines on top. Buttons broad oval with three to five pairs of small holes. Ventral feet with large end plate and broad plate-like supporting rods, often with slitlike holes.

Types: Semper's cotypes are in the Museum of Comparative Zoology, as well as the types of H. L. Clark's *Holothuria frequentiamensis* and *H. altimensis*.

Type localities: Semper's types came from Samoa, as did *Holothuria excellens*. Clark's types came respectively from Clipperton Island, eastern Pacific, and Torres Strait, Australia.

Distribution: From the eastern coast of Africa westward to the tropical coasts of Central America and Mexico.

Depth: Shore, mostly under flat rocks in pools.

Specimens examined: The paratypes and types listed above, and a large series from various localities in different collections, including Bedford's material in the British Museum. One hundred and eight specimens from 22 stations, collected by the *Velero III*. Of these, 46 came from the Galapagos Islands, one from Cocos Island, 8 from Clarion Island, 25 from Panama, 15 from Costa Rica, and 13 from the coast of Mexico, as far north into the Gulf of California as Espiritu Santo Island. The species was not taken at San Lucas or along the west coast of Lower California. Its absence in Socorro Island may be accidental, as the species is common both in Clarion Island and Clipperton Island.

Remarks: The *Velero* material ranges in length from 2 to 8 cm; but as the largest individuals are somewhat contracted, they probably measured at least 10 cm when expanded. The color shows some variation from light brown, almost yellow, to dark purplish brown or black. In many localities the individuals had undergone transverse division, so one finds the usual "stumpy" specimens with too large a tentacle crown and closed posterior end, or a posterior end with a regenerating, pale anterior end, as described by Deichmann in 1922.

The spicules are distinctly different from those of the smaller *Microthele parvula* from the West Indies and Bermuda, as previous studies have shown. In addition, W. K. Fisher found that the Cuvierian organs were ejected as "long sticky threads" in *M. parvula*, while Mortensen found them to be discharged as minute vermicellilike fragments in *M. difficilis* (verbal communication). Whether the green pigment so char-

acteristic of *M. parvula* also occurs in *M. difficilis* is not known, as all the Pacific material has been so well cared for with fresh alcohol that no trace remains in the material I have seen.

The species is common both in Hawaii and in Easter Island, and from the abundance with which it occurs in the Hancock collections one seems justified in considering it a permanent element in the Panamic region.

Clark's *Holothuria frequentiamensis*, from Clipperton Island, was previously withdrawn as a synonym of *Microthele difficilis* and the same fate must befall Deichmann's *Actinopyga bedfordi*, based on some young specimens from Funafuti and Rotuma, identified as *Holothuria parvula* by Bedford. Clark's *Holothuria altimensis*, from Thursday Island, has also proved to be a young *Microthele difficilis* in which a few "synalactid" tables with cross-shaped disk were preserved—a feature which, as the Hancock material has shown, may exist also in other species.

3. *Brandtothuria* n. gen. (*Holothuria arenicola* group)

Diagnosis: Comparatively slender, spindle- or bottle-shaped forms, of moderate size, rarely 25 cm long, with 20 small terminal tentacles and terminal anus. Appendages not numerous, more papilliform on the dorsum, and often distinctly arranged in five bands. Inner anatomy not remarkable except in *Brandtothuria arenicola* (ring canal placed some distance behind the calcareous ring); usually one stone canal and one or two Polian vesicles; Cuvierian organs present, variously developed.

Spicules an external layer of tables with smooth edged disk and, in the adult, a low spire with a varying number of teeth; in young individuals, the spire sometimes tall with several crossbeams. Inner layer of smooth buttons of moderate size, usually with three pairs of holes. Ventral feet with large end plate and supporting rods or plates, dorsally small end plate or none, and supporting rods more narrow and often curved. Usually concealed among rocks or buried in sand or mud.

Type species: *Holothuria arenicola* Semper.

Remarks: At the present moment the genus is restricted to three species, all included by Panning in "*Sporadipus*" without making it clear what characterizes that group. It seems to be a large motley array of mostly unrelated forms. Brandt used the name for two species, *S. ualanensis* and *S. maculatus*, which cannot be identified, although many think that the last named, from Bonin Island, may be the same form

that Semper later called *Holothuria arenicola* (see Fisher, 1907, p. 662).

All three species occur in the Panamic region, but while two of them are extremely common and also occur in the West Indies, the third, with only a few scattered locality records, appears to be a visitor from Hawaii or some other outlying West Pacific island group.

KEY TO THE SPECIES OF THE GENUS *Brandtothuria*

1. Tables stout, with about 8 marginal holes in the almost square disk; spire low, squat, with numerous short spines on the top. Buttons regular with six large holes. Color mottled gray to reddish brown; skin rough to the touch, animals usually strongly warted. Almost circumtropical.
 *impatiens* (Forskål)
1. Tables not remarkably stout; disk circular or with four marginal holes; spire more or less tapering, with a varying number of spines. 2
2. Disk of tables normally circular with several small holes. Buttons delicate, elongate, with six large, narrow holes. Color golden brown with a circular pale area around the appendages, which may be dark brown. Ranges from East Africa to the west coast of tropical America. . . . *gyrifer* (Selenka)
2. Disk of tables often reduced to the central four holes. Buttons small with six small holes, often partly obliterated ventrally. Color whitish gray to light brown, often with two rows of black spots on the back, or small black specks scattered all over the animal. Rusty red or black specimens may be found, stained by the mud in which they live. Almost circumtropical. . . .
 *arenicola* (Semper)

***Brandtothuria arenicola* (Semper)**

Pl. 1, figs. 10-13

Holothuria arenicola Semper, 1868, p. 81, pl. 20; pl. 30, fig. 13; pl. 35, fig. 4. Panning, 1935, IV, p. 88-89, fig. 73, almost complete list of references. Deichmann, 1938, p. 364. Steinbeck & Ricketts, 1941, p. 407.

Holothuria monsunii Heding, 1939, pp. 217-218, figs. 18-26.

Diagnosis: Slender spindle-shaped form, up to 20 cm long, mostly about 10 to 16 cm in length. Feet scattered in indistinct bands, ventrally

cylindrical, dorsally partly papilliform or at least with smaller disk. Internally, ring canal placed exceptionally far behind the calcareous ring. Cuvierian organs present but apparently always small.

Spicules an outer layer of tables with 4 to 8 marginal holes and low spire, often with pillars slightly converging and few small spines on the top. Buttons small, smooth, with six holes, usually smaller on the ventrum, here becoming completely obliterated with age. Ventral feet with end plate and almost straight supporting rods with perforated ends, or with a series of holes along the sides making them into elongate buttons. Dorsal feet with smaller end plate or none, and shorter rods, often curved.

Color white to gray with a varying amount of dark pigment flecks or two rows of dark spots on the dorsum. Some individuals almost black or covered by a reddish pigment, possibly from the mud in which they live.

Type: Possibly in Germany.

Type locality: Bohol, Philippines.

Distribution: Almost circumtropical, in shallow pools, usually concealed in mud or sand. Common in the West Indies, including Bermuda, as well as in Hawaii. In the Panamic region it has been found to range from Ecuador to the upper end of the Gulf of California (30° N). Extremely common in the Galapagos Islands, where 47 individuals were secured at 17 stations. Also taken at Cocos and Clarion Islands.

Depth: Shallow water, mostly hidden in mud or sand, rarely among rocks.

Specimens examined: A large number in various collections. In the Hancock collections more than 150 individuals were examined, ranging in size from 3 to 15 cm.

Remarks: The material from the Panamic regions shows the same lawless variation as that exhibited by the material from the West Indies. Animals with two rows of dorsal spots occurred with others of the same size in which minute specks of black were scattered over the entire animal. As in material from other localities, one often finds no buttons in the youngest individuals (few cm long), and in these the layer of tables is better developed, with larger disk, complete circle of holes, and a taller, more delicate spire.

Steinbeck & Ricketts report the species as fairly common in the Gulf of California and the *Velero* expeditions have proved that it is about the third most common species in the Panamic regions, with the Galapagos Islands being the place where it finds optimum conditions. From here it

was reported by Théel as early as 1886, and later by the *Zaca* and the *Arcturus*, which also reported it from Costa Rica. Ludwig's *Holothuria maculata*, from 66 fathoms off Cocos Island, refers to *Jaegerothuria inhabilis*, while his *Holothuria arenicola*, from shallow water in Panama, is correctly identified.

Strongly contracted specimens have occasionally been mislabelled *Holothuria impatiens*, which occurs in similar localities, though preferably among rocks. Superficially the species resembles *Lessonothuria pardalis*, but the spicules are sufficiently different to prevent a misidentification.

Brandtothuria impatiens (Forskål)

Pl. 1, figs. 14-15

Fistularia impatiens Forskål, 1775, p. 121, pl. 39, fig. B.

Holothuria impatiens, Panning, 1935, IV, p. 86, complete list of references. Deichmann, 1938, p. 365. Steinbeck & Ricketts, 1941, p. 407, pl. 10, fig. 2. Cherbonnier, 1951, p. 29, pl. 9, figs. 8-9.

Diagnosis: Medium-sized form up to about 15 cm long, rarely longer. Often distinctly bottle-shaped with a long "neck." Feet in indistinct rows, large ventrally, more papilliform on the dorsum, often placed on low round warts. Internal anatomy not remarkable; usually with enormous thick tubes of Cuvierian organs.

Spicules a crowded layer of stout tables, with eight large holes, about as large as the central hole. Spire short, stout with one or two cross-beams and a wreath of numerous short teeth on the top. Buttons smooth, regular, usually with six large holes. Feet with end plate, smaller in the dorsal appendages; supporting rods curved, with terminal holes, occasionally with lateral holes, giving them the form of large buttons.

Color mottled gray or brown, sometimes almost uniformly reddish brown. Skin unusually sandy to the touch.

Type: Undoubtedly lost.

Type locality: Red Sea.

Distribution: Almost circumtropical, common in the West Indies, and ranging all over the tropical Indo-Pacific. In the Panamic region, ranging from Colombia to the upper end of the Gulf of California, also in the Galapagos Islands and Cocos Island. Most remarkable is that it occurs on the west coast of Lower California, at Magdalena Bay and Cedros Island.

Depth: Shallow water to a few fathoms, usually well concealed among rocks, more rarely in sand.

Specimens examined: Several in various collections in America and Europe. The Hancock collections contain about 328 individuals, collected at 85 stations.

Remarks: Steinbeck & Ricketts report *Brandtothuria impatiens* as the second most common species in the Gulf, and the methodical collecting of the Hancock expeditions have confirmed this estimate and further shown that it is the most common form in the Galapagos Islands, where 72 individuals were collected at 22 stations. It is a species which usually is represented in all collections, but mostly by few individuals in each. The large number found in the Panamic region may indicate that the conditions there are particularly favorable for this widespread form.

Brandtothuria gyrifer (Selenka)

Pl. 1, figs. 16-18

Stichopus gyrifer Selenka, 1867, p. 319.

Holothuria gyrifer, Deichmann, 1938, p. 371 (discussion of synonymy).

Holothuria monacaria, Panning, 1934, III, p. 69 (*partim*), list of references.

Diagnosis: Slender, spindle-shaped or flask-shaped form, up to 20 cm long, usually less than 15 cm. Resembling *Brandtothuria impatiens* but more delicate, with less rough surface, and skin invariably yellowish brown in color with large pale areas around the appendages, giving a distinct polka dot effect. Anatomy similar to *B. impatiens*, but Cuvierian organs small.

Spicules an external layer of tables with circular disk having up to ten holes, and tapering spire with few spines on tip. Inner layer consisting of regular buttons with six large holes, rather narrow. Ventral feet with large end plate but no special supporting rods, except a few reticulated plates near the end plate or a few perforated rods or elongated buttons. Dorsal appendages usually without end plate, and curved rods with short transverse projections sometimes developing into a row of lateral holes. Synallactidlike tables in young.

Type: Museum of Comparative Zoology.

Type locality: Hawaii.

Distribution: From east coast of Africa to the Panamic region, where it was first reported by H. L. Clark in 1923 and later taken by the *Zaca* expedition.

Depth: Shallow water, concealed under rocks or in sand.

Specimens examined: The type and several specimens in the Museum of Comparative Zoology, and in other collections. Fourteen specimens collected by the Hancock expeditions from seven stations, ranging from Colombia to Las Tres Marias, Magdalena Island, Mexico (about 21° N).

Remarks: That this well characterized and wide ranging species is not a permanent element in the Panamic region is indicated by the comparatively few records and by the small size of the material, 1 to 8 cm. It probably does not reach maturity in this area.

The coloring in this species is a most reliable character, except in cases of the youngest individuals, 1 to 3 cm long, which may be almost uniformly brown; but the spicules are characteristic enough to separate them from similar age groups of *B. impatiens* and *B. arenicola*.

"*Holothuria patagonicus*" Perrier, well figured in his paper of 1905, lacks spicules completely and is undoubtedly a mislabelled specimen in which the spicules have been accidentally dissolved. It has never been taken since the type was described and must be withdrawn as a synonym of *Brandtothuria gyrifer*.

4. *Lessonothuria* n. gen. (*Holothuria pardalis* group)

Diagnosis: Small (10 to 12 cm) spindle-shaped forms resembling *Brandtothuria arenicola*, with small terminal tentacles and few feet or papilliform feet in indistinct rows.

Spicules stout tables with disk round, edge smooth to dentate, often incomplete; spire low with 8 to 12 teeth, often reduced. Buttons in inner layer, numerous, often distinctly in heaps, varying from regular, with 6 to 8 holes, to incomplete, often twisted forms, occasionally with one or two knobs. Feet with end plate, smaller in the dorsal ones, and straight to curved supporting rods with few holes in the expanded ends or transformed into elongate buttons.

Type species: *Holothuria pardalis* Selenka.

Remarks: To this group has been referred only one species which is extremely variable but in which, as all authors seem to agree, the numerous variations cannot be separated. In Panning's revision, the species is placed, with a large number of others, in Group B, ser. 8 (V, p. 3). However, some of the species in this group are synonymous, some belong in other groups, and the few remaining forms, incompletely known as they are, have no close affinities with *Lessonothuria pardalis*.

Lessonothuria pardalis (Selenka)

Pl. 2, figs. 1-17

Holothuria pardalis Selenka, 1867, p. 336, pl. 19, fig. 85. Fisher, 1907, p. 664, pl. 69, figs. 1, 1a-g. Panning, 1935, V, p. 3, fig. 106, complete list of references. Cherbonnier, 1951, p. 31, pl. 9, figs. 17-18; pl. 10, figs. 13-19; pl. 11, figs. 1-11.

Holothuria pardalis var. *cebuensis* Domantay, 1933, p. 70, pl. 3, fig. 4. Panning, 1935, V, p. 4.

Diagnosis: As for the genus. Extremely variable in color, as well as in the shape of the spicules. In some individuals the inner layer of buttons almost entirely composed of regular six-holed buttons, in others almost all deformed, twisted, incomplete or with a few knobs on the surface.

Type: Possibly in Germany.

Type locality: Hawaii.

Distribution: Almost circumtropical, though lacking in the Atlantic Ocean, including the West Indies. Common in Hawaii and extending into the Panamic region, though, judging from the Hancock material, not well established there.

Depth: From tidemark down to a few fathoms. In Hawaii, the *Stranger* collected it at 12 to 20 fathoms.

Specimens examined: Several in various collections. The following specimens from the Hancock expeditions: four recorded from the Galapagos Islands; one from Gorgona, Colombia; one from Cocos Island; two from the Secas Islands, Panama; and one from Tenacatita, Mexico. So far it has not been taken in the sheltered waters of the Gulf of California, which may indicate that it is not a permanent element of the fauna.

Remarks: Fisher observed that it usually occurs under rocks at low tide.

5. Mertensiothuria n. gen.
(*Holothuria leucospilota* group)

Diagnosis: Large smooth-skinned forms with large tentacles, terminal or subventral, with cylindrical ventral feet and small papillae on the dorsum. Inner anatomy not remarkable; Cuvierian organs present.

Outer layer of tables poorly developed, at least in the adult, with disk often reduced to plate with four large central holes and in addition

often some smaller marginal ones; spire low, with few teeth on top, often partly resorbed. Inner layer either buttons, mostly irregular, incomplete, often twisted, or in one species reduced to rods with lateral lobes only rarely developing into complete buttons.

Type species: Stichopus leucospilota Brandt.

Remarks: In this genus have been placed a few of the members of Panning's Abt. B, Reihe 1-3, and some of those referred to his Abt. B, Reihe 8. One species from the latter division has turned out to be identical with the type species, placed in his first division. At the present moment, four species have been included in the genus, all exclusively Indo-Pacific; one is known only from American waters, while the fourth, *Mertensiothuria pervicax*, extends as far eastward as Hawaii.

KEY TO THE SPECIES OF THE GENUS *Mertensiothuria*

1. Spicules in inner layer small oblong rods with lateral projections resembling narrow rosettes, only rarely developed into narrow buttons, mostly incomplete. Mottled. Indo-Pacific as far eastward as Hawaii. *pervicax* (Selenka)
1. Spicules in inner layer buttons, complete or incomplete, rarely regular. 2
2. Buttons mostly with two narrow holes and one to two smaller pairs in the ends, holes often incomplete. Mottled, gray to brown, paler below. Indo-Pacific, including Panamic region. *fuscocinerea* (Jaeger)
2. Buttons variously developed, from almost regular to twisted or irregular or incomplete. 3
3. Tables usually present, with low spire, ending in a flat circle of 8 to 12 short, blunt teeth. Buttons delicate, mostly with large holes, often narrow. Color faded, reddish or brown. From the eastern coasts of Africa to the Panamic region. *leucospilota* (Brandt)
3. Tables usually reduced to four-holed disks, often totally lacking. Buttons stout, mostly incomplete and with holes as a rule round, not narrow. Color bluish black to brown dorsum and pale, more grayish, ventrum. Juan Fernandez Island. *platei* (Ludwig)

***Mertensiothuria leucospilota* (Brandt)**

Pl. 3, figs. 1-9

Stichopus leucospilota Brandt, 1835, p. 51.

Holothuria leucospilota, H. L. Clark, 1920, p. 149.

Holothuria vagabunda Selenka, 1867, p. 334, pl. 19, figs. 75-76. Panning, 1934, III, p. 67, text-fig. 45 (copied from various workers), complete list of references.

Holothuria lamperti Ludwig, 1887, p. 6. Panning, 1934, III, p. 72.

Holothuria oxurropa Sluiter, 1887, p. 190, pl. 1, figs. 3-5. Panning, 1934, III, p. 72, text-fig. 52 (copied from Sluiter).

Holothuria infesta Sluiter, 1901, p. 20, pl. 6, fig. 4. Panning, 1934, III, p. 73, text-fig. 54 (copied from Sluiter).

Holothuria fusco-rubra Théel, 1886, p. 182, pl. 7, fig. 2.

Holothuria curiosa var. *fusco-rubra*, Panning, 1935, V, p. 5.

Holothuria homoea H. L. Clark, 1938, p. 533, text-fig. 56; 1946, p. 438.

Holothuria gelatinosa Heding, 1939, pp. 213-216, figs. 1-17.

Diagnosis: Large, baglike form, rarely contracted, the skin then appearing thick. Tentacles of moderate size, terminal to subterminal; ventrally large tube feet not too numerous, dorsally small papilliform appendages, rather scattered.

An external layer of tables with complete to incomplete disk often reduced to four central holes and 1 to 4 marginal holes, edge smooth to spinous; spire low, likewise often partly reduced, when complete ending in a flattened crown of 8 to 12 blunt teeth. Ventral feet with large end plate and a few broad supporting plates with oblong holes at right angle to the axis; dorsal papillae with reduced end plate or none, and curved rods with perforated ends, often spinous.

Color faded reddish or brown, often paler on the ventrum.

Type: Brandt's types are possibly lost. Selenka's type is in the Museum of Comparative Zoology, as is that of Clark's *Holothuria homoea*, while Théel's are in the British Museum.

Type locality: Brandt's type came from Ualan, Marshall Islands, Clark's from Lord Howe Island, while Selenka's and Théel's material was collected in Hawaii.

Distribution: While Brandt's name has been almost completely forgotten, Selenka's species appears in many reports, with a distribution from the eastern coast of Africa to the Panamic region; an almost identical distribution is indicated for Théel's species.

Depth: Shallow water to a few fathoms.

Specimens examined: Selenka's cotype of *Holothuria vagabunda*; Théel's *Holothuria fusco-rubra* and Clark's *Holothuria homoea*. A large number of specimens in various collections, indifferently identified

as either *H. vagabunda*, *H. leucospilota*, or *H. fusco-rubra*. The Hancock expeditions have brought back 32 specimens from five stations in the Galapagos, Clarion, and Socorro Islands, with the majority of the material coming from the Galapagos region. A number of particularly large, well developed, mature individuals were collected by an expedition from the Scripps Institution of Oceanography to Clipperton Island, indicating that the species obviously is at home in that locality.

Remarks: When one compares the original descriptions of *Holothuria vagabunda* and *H. fusco-rubra*, as well as various later, often extremely careful accounts, one is struck by the impossibility of finding any character which definitely separates these two forms. Théel seems to be one of the few workers who claims to have had both "species" before him, and he emphasizes the strong affinities which his species has with *H. vagabunda* and "*H. curiosa*." All other writers have identified their material as one or the other of the two forms or have established a new species. Panning examined *H. vagabunda* but relied on the accounts of other authors for his description of *H. fusco-rubra*, which he placed in an entirely different group. Both "species" came from Hawaii, and as both were based on large individuals about 20 cm long in preserved condition, one cannot accept one species as the juvenile and the other as the senescent stage of the same form.

Although little attention has been paid to Brandt's name, *Stichopus leucospilota*, there is no doubt that it rightly supersedes both Selenka's and Théel's names. Lampert was fully aware of this fact but decided to retain Selenka's name. In 1920, H. L. Clark changed *Holothuria vagabunda* to *Holothuria leucospilota*; and since the change has been made and incorporated in his two large works on the Australian echinoderms, it is to be hoped that future writers will follow his decision and also drop Théel's name *fusco-rubra*.

Mertensiothuria platei (Ludwig)

Pl. 3, figs. 10-12

Holothuria platei Ludwig, 1898, p. 432, pl. 26, figs. 1-14. Deichmann, 1924, p. 381, text-fig. 1. Panning, 1935, V, p. 11, text-fig. 118.

Diagnosis: Large form, up to 23 cm long, stout, cylindrical, with 20 large bushy tentacles, and a large number of cylindrical tube feet on the ventrum and somewhat fewer small papillae on the dorsum. Inner anatomy not remarkable.

Spicules a scattered layer of tables, often overlooked, with disk reduced to four central holes and a few marginal ones, and an often in-

complete spire. Buttons clumsy, often slightly angulate and mostly incomplete; holes mostly circular or broad oblong, not slitlike. Ventral feet with end plate and elongate supporting rods with a complete or incomplete series of holes around the edges. Dorsal papillae with small end plate and shorter supporting rods.

Color varying from light brown, with pale grayish white underside, to almost black dorsum; tentacles dark, ventral feet usually pale with darker end disk.

Type: Hamburg.

Type locality: Juan Fernandez Island, Chile.

Distribution: Known only from the type locality.

Depth: Collected at tidemark.

Specimens examined: Various individuals in the Museum of Comparative Zoology, Zoologisk Museum, Copenhagen, and Riksmuseet, Stockholm.

Remarks: The species appears to occupy a rather isolated position, but with its reduced tables and large irregular buttons it seems to belong most naturally with the *Mertensiothuria leucospilota* group. From the size of the bushy tentacles and the numerous tube feet, one is inclined to think that its mode of life is similar to that of the members of the *Selenkothuria lubrica* group, attached to rocks in the surf zone, and possibly using its tentacles for collecting a certain amount of planktonic detritus; as far as I know there are no observations on its biology.

The species is included in this report, as it possibly may be found on the shores of the mainland and even extend its range into the Panamic region.

***Mertensiothuria fuscocinerea* (Jaeger)**

Pl. 3, figs. 13-23

Holothuria fusco-cinerea Jaeger, 1833, p. 22. Semper, 1868, p. 88, pl. 27 (in color); pl. 30, figs. 22a-b. H. L. Clark, 1946, p. 435.

Holothuria curiosa Ludwig, 1875, p. 110, pl. 7, fig. 29. Panning, 1935, V, p. 4, text-fig. 107 (copied from Théel), complete list of references.

Holothuria pluricuriosa Deichmann, 1937, p. 166, text-fig. 1, nos. 11-20.

Holothuria pseudo-zacae Cherbonnier, 1951, p. 23, pl. 6, figs. 1-19, 21.

Diagnosis: Large form, up to 30 cm long, with 20 large ventral tentacles and not too crowded appendages; cylindrical feet on the ventrum and papillae on the dorsum. Inner anatomy not remarkable. One

or two Polian vesicles, one or more small free stone canals; large Cuvierian organs present.

Spicules an external layer of tables, usually scattered, with round to squarish disk, often reduced to 3 or 4 central holes and some marginal holes; spine low, often reduced to one rod; if complete, the crown consists of 1 to 4 spines. Inner layer of small buttons, often incomplete, approaching the rosette form of *M. pervicax* (Pl. 3, figs. 24-29); the typical button has two narrow slitlike holes and one or two pairs of minute holes in the ends. Ventral feet with end plate and elongate perforated rods or plates, more or less buttonlike; dorsal papillae with rudimentary end plate and mostly narrow supporting rods.

Color variable, dorsal side ash-gray or brownish, more or less mottled, papillae often with a black area around the base, with a narrow white ring inside it. Ventral side pale gray with a velvet black ring around the base of the retractile feet, which have a pale disk.

Type: Probably not existing in any collection. Semper's specimen upon which he based his excellent description may possibly be in some collection in Germany, where Ludwig's *Holothuria curiosa* may also be kept; *H. pluricuriosa* is in the Museum of Comparative Zoology.

Type locality: Celebes, where Semper's material also came from; *Holothuria curiosa* was collected at Bowen, Australia, and *H. pluricuriosa* came from Santa Ines Bay, Gulf of California.

Distribution: As far as can be ascertained, the species ranges from Ceylon (Pearson), Australia (H. L. Clark and others), Navigator Island (Théel), Samoa and the Philippine Islands (Semper), to the Panamic region. Apparently not reported from the Hawaiian Islands, where *Mertensiothuria pervicax* occurs.

Depth: Shore down to a few fathoms.

Specimens examined: Several in the Museum of Comparative Zoology, from Mer Island, Torres Strait, etc. The type of *Holothuria pluricuriosa*, and the 17 specimens collected at eight stations by the Hancock expeditions, all in the Gulf of California, about 24°-25° N, near Espiritu Santo Island and Escondido, from tide level to 12 fathoms.

Remarks: Panning indicates a length of 10 cm for *Holothuria curiosa*, but Jaeger gives 5 or 6 inches (15 to 18 cm), and Théel, who had occasion to investigate both "species," mentions 18 and 22 cm. Although Jaeger's description is brief, I think it is justifiable to maintain his name, particularly as Semper has given an adequate description based on a series from Jaeger's type locality, Celebes, as well as from Samoa and Bolo. This view is also that held by H. L. Clark in 1946.

That *Mertensiothuria fuscocinerea* is not the last growth stage of *M. pervicax* is certain, since small individuals have been found having the typical egg-shaped buttons with two narrow holes and sometimes one or two pairs of minute holes. Also the Museum of Comparative Zoology possesses huge individuals of typical *M. pervicax*. That the two species are closely related seems evident and they may possibly represent different ecological forms. Judging from the literature and the available material, *M. pervicax* ranges from Zanzibar and the Red Sea to Hawaii.

Re-examination of *Holothuria pluricuriosa* and comparison with other individuals of *Mertensiothuria fuscocinerea* have proved that several stone canals occur frequently in the latter species and that there is an end plate in the retracted feet of the former; therefore *Holothuria pluricuriosa* must be withdrawn as a synonym of Jaeger's old name.

The Panamic material tends to be more dully colored, with larger brown patches on the dorsum, than the typical ash-gray form from the East Indies, and the black areas around the papillae are less clearly pronounced. Nevertheless I do not feel justified in establishing a separate form on the basis of the comparatively few specimens I have examined.

6. *Semperothuria* n. gen. (*Holothuria languens* group)

Diagnosis: Slender forms, cylindrical to flask-shaped, of moderate size, 10 to 15 cm, rarely 20 cm, with 20 small terminal tentacles and feet in five scattered bands, cylindrical on the ventrum, more papilli-form on the dorsum. Inner anatomy not remarkable; Cuvierian organs well developed.

Spicules a crowded layer of tables normally lacking the disk completely and with the tip of the spire ending in a few large teeth, forming a single or double Maltese cross. Rarely a few tables also present with four upward directed spines, or with a complete disk, with smooth or spinous margin. In some species an inner layer present in the form of scattered large, flat bars with dentate edge or a series of large lateral holes. Ventral feet with large end plates, often surrounded by a number of perforated oval plates; numerous large supporting rods in the walls. Dorsal papillae with reduced end plate and usually curved supporting rods.

Color varying shades of purplish gray or brown, paler around the appendages and on the ventrum. Sometimes black dots scattered on the

back, occasionally fusing into larger black spots in two rows. Tentacles pale yellow, except in *Semperothuria flavomaculata*.

Type species: Holothuria languens Selenka.

Remarks: Panning's *imitans* group is accepted with the exclusion of *H. edulis* Jaeger, which is placed near the *atra* group for the present. *H. languens* is proposed as the type of the genus as it is older than *H. imitans* and the Hancock material has shown that it is well defined, although in the past it has often been confused with *H. imitans*, which likewise occurs in the Panamic waters.

KEY TO THE SPECIES OF THE GENUS *Semperothuria*

- 1. Most tables with flattened base; pillars parallel and ending in eight spines forming a single flat Maltese cross. Supporting rods in feet and papillae mostly narrow, with perforated ends, occasionally with lateral holes. Indo-Pacific. *imitans* (Ludwig)
- 1. Most tables with base tapering to a cone, with or without a few spines; pillars rarely parallel, ending in a double Maltese cross on top of spire. Large bars scattered in the skin. 2
- 2. Numerous spines or rough areas on the broad bars in the skin. Several stone canals. Tentacles dark. Samoa to Batavia. *flavomaculata* (Semper)
- 2. Bars in skin smooth or rarely with a few spines. Single stone canal. Tentacles lightly colored. 3
- 3. Bars usually with dentate edge, rarely closing to form a series of lateral holes. Large form, up to 20 cm long. West Indies, possibly also West Africa. *surinamensis* (Ludwig)
- 3. Bars usually with marginal row of holes, rarely with a few spines present. Small form, to 10 cm long. Panamic region. *languens* (Selenka)

Semperothuria languens (Selenka)

Pl. 4, figs. 5-7

Holothuria languens Selenka, 1867, p. 335, pl. 19, figs. 80-81. Panning, 1934, II, p. 44, fig. 37 (copied from Selenka).

Non Holothuria languens, Deichmann, 1930, p. 64, pl. 3, fig. 16; 1938, p. 367, text-fig. 3. (In both cases, *H. imitans* Ludwig)

Diagnosis: Length up to about 10 cm. Tables fairly stout, basal part usually conical with a few spines and the top carrying two sets of spines, forming a double Maltese cross; often small spines intercalated between the typical eight pairs, especially in the few tables with the disk still preserved. A scattered deeper layer of flat rods or bars, with marginal holes or dentate edge. Ventral feet with large end plate and large supporting plates with lateral holes; dorsal appendages with small end plate or none and shorter, usually curved, rods, often with dentate ends.

Color usually dull grayish brown with slightly paler area around the appendages and a varying number of dark dots, sometimes fused to two rows of dark spots on the dorsum; ventral side usually paler.

Type: In Germany; paratypes in the Museum of Comparative Zoology.

Type locality: Panama.

Distribution: Apparently restricted to the waters around Panama and a few localities along the coast of Mexico, including Cape San Lucas.

Specimens examined: Selenka's co-types and sixteen specimens secured by the Hancock expeditions in Panama, Bahia Honda, and Taboga Island; Mexico, Tenacatita Bay, Las Tres Marias, Los Frailes, and Cape San Lucas. All ranging from 4 to 10 cm in length and mostly dull grayish brown in color.

Remarks: Selenka's description and figures, though far from perfect, leave no doubt as to which species he had before him. He figured the characteristic spinous conical base of the table and attempted to figure the top with its two circles of spines. Among the large rods, he unfortunately selected one with lateral teeth not united into marginal holes. His types have been re-examined and it was discovered that two of his seven specimens were *Semperothuria languens*, one was a contracted specimen of *Selenkothuria portovallartensis*, and four were *Semperothuria imitans*. This explains why Deichmann in 1930 was misled into thinking that Selenka's species was characterized by tables with a single circle of spines (as in *S. imitans*).

The species is obviously closely related to *Semperothuria surinamensis*, the common species in the West Indies, and Semper's reference to "*H. languens*" in that region refers undoubtedly to that species. The rather restricted distribution of *Semperothuria languens* seems to indicate that it is derived from West Indian stock, while the more common form, *S. imitans*, has come from the West Pacific.

Semperothuria imitans (Ludwig)

Pl. 4, figs. 8-12

Holothuria imitans Ludwig, 1875, p. 109, pl. 7, fig. 41. Théel, 1886, p. 208; 1886a, p. 7. Panning, 1934, II, p. 39, fig. 33, complete list of references. Cherbonnier, 1951, p. 18, pl. 4, figs. 1-15.

Holothuria languens Deichmann, 1930, p. 64, pl. 3, fig. 16; 1938, p. 367, text-fig. 3.

Diagnosis: About 10 cm long, resembling *Semperothuria languens* but appearing more delicate, with a clearer purplish brown coloring, a more distinct pale area around the base of the appendages, and more distinct dark dots or spots. Tables predominately with flat base and parallel pillars in the spire; spire topped by a flat Maltese cross formed by eight spines, rarely a few accessory ones. Complete tables with smooth to spinous disk edge occur, mostly near the appendages, and these often have more irregular clusters of spines on the top—projecting upward or approaching the double Maltese cross in shape. Feet with large end plate, with a few perforated plates around the edge and a number of curved rods or bars, with or without perforated ends and sometimes with lateral projections occasionally forming marginal holes. Similar rods in the dorsal appendages, with the end plate reduced or lacking.

Type: Possibly in Germany.

Type locality: Samoa.

Distribution: In the Pacific Ocean, known with certainty from Samoa (Ludwig), Panama (Théel), and numerous localities along the west coast of the Panamic region, including the Galapagos and other outlying islands.

Depth: Shallow water, usually under flat rocks in pools.

Specimens examined: Several in the Museum of Comparative Zoology, hitherto mistakenly listed as *Semperothuria languens*. A series of 110 specimens, ranging in size from 2 to 10 cm, collected by the Hancock expeditions. The species is common in the Galapagos Islands, where a complete series (2 to 10 cm long) was secured from 16 different stations. It was also taken at Clarion and Cocos Islands, and the Secas Islands, Panama. The remaining records are from the coast of Mexico, from Isabel Island to off Guaymas, at about 27° N, in the Gulf of California.

Remarks: A comparatively large number of small individuals were secured, with a few of the typical spicules but with a preponderance of juvenile tables with large, fragile disk and tapering spire, with several crossbeams and minute blunt teeth. There is of course the possibility

that some of these individuals may represent the young of *Semperothuria languens*, which must have quite similar spicules. However, as far as the present material goes, none of these small individuals were taken where adult specimens of *S. languens* occurred. Both species were preserved in the bottle which contains Selenka's paratypes from Panama, but there is no way of knowing whether this actually represents the one case in which both were found in the same locality, or whether specimens from different localities were lumped together under the general label "Panama."

7. *Irenothuria* n. gen.

Diagnosis: Large species, 20 cm or more, cylindrical to bottle-shaped, with 20 tentacles of moderate size and almost terminal in position. Ventral feet cylindrical, large, arranged in irregular double rows; dorsally the feet more papilliform and arranged in the same manner. Calcareous ring delicate, low; one Polian vesicle and one free stone canal with round head. Cuvierian organs present in some individuals.

Spicules a crowded layer of tables. The largest tables with a disk about 0.2 mm in diameter, with numerous holes and a tall spire with a crossbeam near the base and four long smooth pillars turning outward near the tip, each tapering to a point. Smaller tables also present, especially in the appendages—with shorter spire, often reduced to 1 to 4 knobs or completely lacking. Ventral feet with large end plate; dorsal papillae with no end plate but sometimes a few supporting rods with a few perforations near the ends.

Type species: *Irenothuria maccullochi* n. sp.

Remarks: The genus is monotypic and has been established to accommodate one of the most striking shallow water forms brought home by the *Velero* expeditions. The species was first collected by T. Mortensen in Panama in 1916 but no description was published, as it seemed impossible that so large and unusual a form could be undescribed.

Irenothuria maccullochi sp. nov.

Pl. 4, figs. 1-4

Diagnosis: As for the genus.

Type: Allan Hancock Foundation.

Type locality: Puerto Utria, Colombia, *Velero III* station 232-34.

Distribution: According to our present knowledge, from Puerto Utria, and Octavia Bay, Colombia; Bahia Honda, Panama; Puerto Culebra, Costa Rica; to Ballenas Bay, Gulf of California.

Depth: Intertidal.

Specimens examined: One specimen from Panama, collected by Th. Mortensen (Copenhagen); five collected by the Hancock expeditions, from five stations.

Remarks: The Hancock material ranges in length from 4 to 20 cm. No striking differences were found between the spicules in these different age groups except that they become slightly larger with advancing age.

Although the species is fairly large and occurs at tide level, it must undoubtedly be rare. Superficially it resembles an unusually dark colored *Brandtothuria impatiens*, and it has probably a very similar mode of life. As far as I can judge from the literature, there is no other species which bears the remotest similarity to this form.

It is a great pleasure to name this unusual form, which occupies a position all by itself, for Dr. Irene McCulloch of the University of Southern California.

8. *Vaneyothuria* n. gen. (*Holothuria lentiginosa* group)

Diagnosis: Large cylindrical forms with up to 20 ventral tentacles and terminal anus; ventral feet varying in number, not crowded and completely retractile; dorsally papillae and smaller feet, the former often on warts, sometimes forming a conspicuous edge along the sides. Inner anatomy not remarkable; one Polian vesicle, one or more stone canals with short cylindrical head, Cuvierian organs present in all forms.

Spicules an outer layer of tables with large disk, with smooth to dentate margin; spire of moderate height, ending in a few sharp teeth, mostly with eight lateral ones forming a more or less irregular Maltese cross and also 4 to 6 vertically placed spines. An inner layer of large buttons, often irregular, slightly twisted, incomplete, or with a few warts; with age, smaller, more regular buttons dominate. Buttons apparently lacking completely in one local form (*Vaneyothuria zacae* forma *azacae*). Ventral feet with end plate and long supporting rods or plates, often as narrow buttons, more or less irregular; dorsal appendages with small end plate or none, and rods or plates, often curved.

Color variable, paler on the ventrum, darker dorsally, gray or brownish, rarely almost white, sometimes with two rows of darker spots dorsally; usually all the appendages, ventrally as well as dorsally, with dark tips and a paler area around the base, not very noticeable on a pale ground color.

The species living normally at remarkably great depth, 50 to 250 fathoms, rarely at 10 to 14 fathoms or less.

Type species: Holothuria lentiginosa v. Marenzeller.

Remarks: In this genus has been included a number of species that Panning, in his revision, scatters in different groups. The oldest is the type species, known from the eastern Atlantic and the West Indies; next come *Holothuria integra* Koehler and Vaney, from the Gulf of Bengal, and *H. neozelanica* Mortensen, from New Zealand, (possibly a synonym of *H. integra*); and finally *H. zacaе* Deichmann, from the Panamic region. With some doubt, I have also included *H. minax* Théel, from 10 to 14 fathoms, in Japanese waters, a well characterized species and not a synonym of *Stichopus gyriter* (Selenka) (= *Holothuria monacaria* of Panning and others).

KEY TO THE SPECIES OF THE GENUS *Vaneyothuria*

1. Tables robust, rarely with marginal spines; spire ending in about 12 sharp teeth, fairly regularly developed. Buttons robust, of great variability, ranging from small, almost regular to large, more contorted. Color golden brown, paler below with pale area around the appendages. Japanese waters, moderate depth, 10 to 14 fathoms. *minax* (Théel)
1. Tables delicate, mostly with some marginal spines. Buttons usually delicate, often twisted, sometimes with a few knobs. Normally from greater depths. 2
2. Color shades of light brown, paler ventrum. Tables mostly with smooth margin. Atlantic form.
. *lentiginosa* (v. Marenzeller)
2. Color shades of gray and brown. Tables usually with spinous edge. Indo-Pacific forms. 3
3. Dorsal side grayish brown. 4
3. Dorsal side with two rows of dark brown, almost black, spots, in one form reduced to a small area around some of the dorsal papillae. 5
4. Gulf of Bengal. *integra* (Koehler & Vaney)
4. New Zealand waters. *neozelanica* (Mortensen)
5. Pale form, except for the dark spots on the back and the dark tips of the appendages, with a varying amount of light brown on the dorsum, giving a light tortoise-shell effect. Inner layer of buttons lacking. Galapagos Islands.
. *zacaе* (Deichmann) forma *azacaе* n.f.

5. More or less dark grayish-brown forms. 6
6. Dorsal spots large, general impression a dark tortoise-shell pattern. Gulf of California. . *zacae* (Deichmann) forma *typica*
6. Dorsal spots reduced to a narrow area around some of the dorsal papillae. Color gray-brown, with a faded area around the appendages, giving a general dull, mottled effect. Waters around Cedros and Guadalupe Islands, west coast of Lower California. *zacae* (Deichmann) forma *iota* n.f.

Vaneyothuria zacae (Deichmann) formae *typica*, *azacae*,
n. f., and *iota*, n. f.

Pl. 5, figs. 1-12

Holothuria zacae Deichmann, 1937, p. 168, text-fig. 1, nos. 21-28.

Diagnosis: As for the genus, but with two rows of dark spots on the back, in forma *iota* reduced to a dark area around some of the dorsal papillae. Tables fragile, mostly with marginal teeth; in the typical form, sometimes with larger tables near the appendages, with a partly reduced spire ending in four blunt rods. Inner layer narrow buttons, often twisted, incomplete, with a tendency to become smaller and more regular with advancing age—lacking in forma *azacae*, which in addition is unusually pale except for the dark spots and the dark tipped appendages.

Types: The typical form is in the Museum of Comparative Zoology; forma *azacae* and forma *iota* are in the Allan Hancock Foundation.

Type localities: The typical form was taken in Santa Inés Bay, Gulf of California; forma *azacae* came from the Galapagos Islands and forma *iota* from off Cedros Island, west coast of Lower California.

Distribution: The typical form is common in the Gulf of California; one record from Ecuador(?); and none between these two localities; forma *azacae* appears to be restricted to the Galapagos Islands; while forma *iota* is known from off Cedros and Guadalupe Islands.

Depth: Most records are from about 50 fathoms down to 120 fathoms; the few specimens of the typical form, from 10 fathoms and "shore," look definitely beach worn.

Specimens examined: The type and 20 specimens of the typical form; 15 of forma *azacae* and four of forma *iota*.

Remarks: All the material consists of large individuals, mostly about 20 cm in length, with a few measuring only 15 cm. As the material of forma *iota* is much stouter and strongly contracted, it probably

measured 30 to 35 cm when fully expanded. From the large number of specimens taken in the Gulf of California, the species must be fairly common there; and it is remarkable that not one single small individual has been captured. Possibly the younger individuals live at greater depth or are better concealed.

Except for the presence of the rows of dark spots on the back, the species appears to be closely related to *Vaneyothuria integra* and *V. neozelanica*. This is particularly true of *V. z. forma iota*, in which the black spots are reduced to small areas around some of the dorsal papillae—a character which may possibly have been overlooked in these two older species. In the larger individuals of the typical form, as well as in *V. z. forma iota* (of which only colossal individuals are known), there is an increase in the number of small regular buttons, making the inner layer of buttons similar to that of *V. minax* (Théel) from the Japanese waters. The latter seems to be a less specialized form from shallower water, and still retains the stouter tables of a shore form.

The name *azacae* seems most appropriate for the Galapagos form in which the inner layer of buttons is completely lacking. The name *iota* was selected for the West coast form because some one working with the material had recognized that it differed from that secured in the Gulf of California, and had marked it with the letter "J."

9. *Ludwigothuria* n. gen. (*Holothuria atra* group)

Diagnosis: Large robust forms with large tentacles subventrally directed; numerous feet on the ventrum, sometimes completely retracted, and a large number of smaller feet and papilliform appendages on the dorsum, in some forms tending to become distinct warts. Inner anatomy not remarkable. Some species with numerous stone canals.

Spicules an external layer of tables, not crowded, with small disk, well developed spire, and one crossbeam; spire with 12 teeth, 4 erect and 8 horizontal, forming a Maltese cross. Inner layer consisting of a varying number of minute rosettes or plates derived from these, or slightly larger plates derived from small bifurcate rods. Ventral feet with large end plate and a differing number of narrow to broad supporting rods or plates, with few to many perforations. Dorsal appendages with vestigial end plate or none, and curved to straight rods.

Color ranging from coal black to mottled gray, or with a dark upper side, or reddish to dull gray. Shallow water forms, mostly lying freely exposed in the lagoons.

Type species: Holothuria atra Jaeger.

Remarks: Panning's group is accepted with minor changes. It consists of three West Indian species and two Indo-Pacific forms; the latter are the widespread type species, which reaches the Panamic region, and *Ludwigothuria kefersteini* (Selenka), which appears to be endemic there.

As there seems to be some misunderstanding about *Ludwigothuria atra* and its occurrence in the West Indian waters, a key is given to all five species.

KEY TO THE SPECIES OF THE GENUS *Ludwigothuria*

- 1. Spicules mostly as simple rosettes. Numerous stone canals. 2
- 1. Spicules mostly as small plates with large to small holes. 3
- 2. Smooth-skinned, color uniformly dark brown or black. Rosettes scattered, chiefly derived from forked rods, often forming oval plates with four holes. Indo-Pacific. *atra* (Jaeger)
- 2. Rarely completely brown or black, mostly grayish-yellow, mottled with large dark blotches. Area around base of appendages, if black, usually with white specks, due to the accumulated rosettes. The latter chiefly derived from 3-armed bodies. West Indian waters. *floridana* (Pourtales)
- 3. Stone canal single. Plates with relatively large holes and often with short blunt teeth along the edge. Speckled white, black, and gray*; dorsal side often strongly warted. West Indian waters, Brazil, West Africa. *grisea* (Selenka)
- 3. Numerous stone canals. 4
- 4. Smooth, thick-skinned form, rarely with indication of warts. Spicules mostly minute plates with small holes, derived from 3-armed rosettes. Usually dark brown dorsal side and pale underside. West Indies. *mexicana* (Ludwig)
- 4. Not particularly smooth or thick-skinned form, usually with well pronounced warts on the dorsum. Spicules in inner layer a few plates with large holes and usually with blunt teeth along the margin. Color reddish to almost black or fading to a dull grayish, with tips of appendages dark. Panamic region. *kefersteini* (Selenka)

*Fisher indicates that it is a harlequin of bits of color in life but fades to a "salt and pepper" effect in alcohol. (Deichmann, 1926)

Ludwigothuria atra (Jaeger)

Pl. 2, figs. 18-23

Holothuria atra Jaeger, 1833, p. 22. Panning, 1934, II, p. 30, fig. 22, complete list of references.

Diagnosis: Large form, 20 cm or more, with cylindrical smooth body and large tentacles slightly ventrally directed. Numerous soft, retractile feet on the ventrum; dorsal side with more scattered papillae and small feet. Inner anatomy not remarkable, except for the presence of a large number of stone canals, and often with several Polian vesicles. Cuvierian organs apparently absent.

Spicules tables with a small disk having four marginal holes and well developed spire with the pillars parallel in the upper half and ending in 12 sharp teeth. Inner layer consisting of scattered rosettes, often bifurcate and sometimes forming oval buttons. Feet with large end plate and few, perforated plates, sometimes H-shaped; dorsal appendages with minute end plate or none, and apparently lacking all supporting rods or plates. Color uniformly black or dark brown.

Type: Presumably lost.

Type locality: Celebes.

Distribution: From Mozambique to Hawaii; also reported from the Galapagos Islands and Cocos Island in the Panamic region, and Clipperton Island (H. L. Clark, 1902).

Depth: Shallow water, in lagoons.

Specimens examined: Several in various collections. In the Hancock material are 14 specimens, of which 13 came from the Galapagos and one from Cocos Island; all moderately large, 9.5 to 15 cm long.

Ludwigothuria kefersteini (Selenka)

Pl. 2, figs. 24-26

Stichopus kefersteinii Selenka, 1867, p. 318, pl. 18, figs. 37-40. H. L. Clark, 1922, p. 46 (referred to *Holothuria*). Boone, 1933, p. 156, text-fig. 8.

Holothuria inornata Semper, 1868, p. 252, pl. 40, fig. 1. Deichmann, 1938, p. 365, text-fig. 2. Panning, 1934, II, p. 33, fig. 28.

Diagnosis: Large species, 20 cm or more, with 20 large, almost terminal tentacles. Ventral feet cylindrical, not crowded; dorsally usually four to six rows of low warts, each carrying a small papilla and with smaller, more or less cylindrical feet scattered between them. Inner anatomy not remarkable except for the presence of numerous small stone canals and three or four Polian vesicles.

Spicules an external layer of tables with small or completely reduced disk, often with a few marginal spines; spire well developed, with one cross-beam and four erect and eight laterally projecting teeth; the tables often partly reduced, with either disk or teeth resorbed. An inner layer of scattered small perforated plates, mostly with two to four large central holes and some smaller terminal ones, and a margin with blunt teeth—a deposit definitely derived from the forked rod. Ventral feet with large end plate and narrow to broad supporting plates, more or less symmetrically developed, with numerous holes in the expanded ends; dorsal papillae and feet with vestigial end plate or none, and curved to straight rods with perforated ends.

Color of preserved individuals ranging from almost black with a reddish tinge to a dull putty gray with reddish warts, dark-tipped appendages, and black tentacles.

Type: *Ludwigothuria kefersteini* is in the Museum of Comparative Zoology; *Holothuria inornata* is in Hamburg.

Type locality: Selenka's species came from Acapulco and Semper's from Mazatlán, both on the west coast of Mexico.

Distribution: Common in the Galapagos Islands and also reported from Cocos, Clarion and Socorro Islands. On the mainland from Peru, Ecuador, Panama, and Costa Rica, to the coast of Mexico.

Depth: Shallow water, in lagoons.

Specimens examined: Selenka's type and, thanks to Dr. Panning in Hamburg, Semper's type; several individuals in various collections. From the Hancock expeditions, 75 specimens collected at 40 stations. Of these stations, 21 were in the Galapagos Islands, 2 at Socorro Island, 3 at Clarion Island, and the remainder ranged from Peru to the coast of Mexico.

Remarks: That *Holothuria inornata* was a synonym of *Ludwigothuria kefersteini* was unfortunately not realized until some time after the Zaca report was published. H. L. Clark recognized that *kefersteini* was a true *Holothuria* and not a *Stichopus*, but Panning was unaware of this fact, hence the species was not included in his revision of the genus *Holothuria*. He did recognize that *H. inornata* was related to *Ludwigothuria atra*, and placed it in the same division.

The types of *Ludwigothuria kefersteini* are small immature specimens, while Semper's type measures about 20 cm in length. The Hancock material ranges in size from 2 to 20 cm and shows considerable variation both in the external appearance and color and in the development of the spicules.

Panning's record of *Ludwigothuria atra* from the Galapagos refers undoubtedly to Clark's record from Clipperton Island, which Clark had mentioned in his Galapagos report. However, as *L. atra* is rather common in the Galapagos Islands, his statement stands. The first record of *L. atra* in the Panamic region is Clark's 1902 listing of 9 specimens from Clipperton Island.

10. *Selenkothuria* n. gen.
(*Holothuria lubrica* group)

For literature, see Panning, 1934, II, pp. 45-48, text-figs. 38-42.

Diagnosis: Soft-skinned forms with numerous cylindrical feet, forming a more or less distinct ventral sole, sometimes arranged in three broad bands; dorsally numerous minute papillae, not conspicuous, rarely forming low warts. Tentacles more or less terminal in position, often bushy, adapted for plankton catching (?). Inner anatomy not remarkable; certain species with numerous stone canals, others with a single large one; usually one Polian vesicle; gonads as divided threads in a tuft behind the low calcareous ring; Cuvierian organs present in all forms.

An external layer of tables usually completely lacking, though vestiges of tables sometimes found in young individuals of certain species. The inner layer consisting of small rods or plates, smooth or spinous. Ventral feet with large end plate and walls supported by rods or plates of same size as those in the skin, rarely special supporting rods present. Dorsal appendages with reduced end plate or none, and often more curved, shorter rods.

Color dull gray with or without two rows of dark spots and darker anterior end, or dark brown to black.

Type species: *Holothuria lubrica* Selenka.

Remarks: Although Panning's group is correctly interpreted, he has unfortunately been so loaded down with most of the errors made by earlier writers that many of his conclusions about distribution are completely misleading. Thus his figures of *Holothuria lubrica* var. *glaberrima* represent *H. erinaceus* Semper (= *H. marenzelleri* Ludwig), entirely different from Selenka's *H. glaberrima*, from the West Indies; while the Indo-West Pacific material of *H. lubrica* var. *lubrica* definitely must be referred to *H. moebi*, Ludwig, and so forth.

In order to clarify the situation a key is given to all the accepted species with their approximate geographic distribution.

KEY TO THE MEMBERS OF THE GENUS *Selenkothuria*

1. Spicules as rods, usually with finely spinulated surface; mostly simple with a small hole in each end, rarely with a series of lateral projections sometimes forming a series of holes. Stone canals numerous. From Mauritius to southern Japan. Type locality: Hong Kong, China. *moebi* (Ludwig)
1. Spicules as rods or plates, smooth to dentate; if finely dentate surface, then numerous holes along the edges. Stone canal single, or rarely two. 2
2. Spicules as rods. 3
2. Spicules as plates. 5
3. Rods short, straight, with few stout spines; rarely a few branching or curved. Cape of Good Hope to Gulf of Persia. Type locality: Natal, South Africa. *parva* Lampert
3. Rods mostly curved. 4
4. Spicules delicate curved rods with indistinct spines and mostly a small hole in each end. Brown to almost black. West Indian waters. Type locality: Haiti, W. I.
. *glaberrima* (Selenka)
4. Spicules curved rods, rarely with perforated ends (in the tube feet), and strongly to moderately spinous surface. Color varying from grayish, with or without two rows of black spots on the back, to black, with sulphur-colored disks on ventral feet. Panamic region, including the Galapagos Islands. Type locality: Acapulco, Mexico. *lubrica* (Selenka)
5. Spicules plates and broad bars, often curved, with numerous marginal or terminal holes; surface of the margin often spinous. Galapagos to west coast of Mexico. Type locality: Puerto Vallarte, Mexico. *portovallartensis* (Caso)
5. Spicules smooth, perforated plates or broad rods with a few holes along the margin of the deposits. 6
6. Spicules predominately plates or short rods with usually few holes and more or less dentate margin. Galapagos Islands and a few localities along the tropical shores of America. Type locality: Galapagos Islands. *theeli* Deichmann
6. Spicules predominately short flat rods, often with forked ends and few lateral or terminal holes. Nicobars, East Indies, including the Philippines. Type locality: Bohol, Philippines (and Nicobars)
. *erinaceus* (Semper) (= *Holothuria marenzelleri* Ludwig)

Selenkothuria lubrica (Selenka)

Pl. 6, figs. 1-17

Holothuria lubrica Selenka, 1867, p. 329, pl. 18, figs. 59-60. H. L. Clark, 1923, p. 162. Deichmann, 1937, p. 165; 1938, p. 368, text-fig. 4, nos. 1-5. Cherbonnier, 1951, p. 22, pl. 5, figs. 1-11, 13. Caso, 1954, p. 418, pls. 1-3, 127 figs.

Holothuria lubrica var. *lubrica* (*partim*) Panning, 1934, II, p. 45, list of references (fig. 38, copied from Lampert, refers to *Selenkothuria moebi* (Ludwig), etc.)

Holothuria kapiolaniae Bell, 1887, p. 533, pl. 45, fig. 5. Fisher, 1907, p. 653.

Non Holothuria lubrica, Sluiter, Pearson, *et al.* (See Panning, 1934, II, p. 45; all refer to *Selenkothuria moebi* Ludwig.)

Holothuria pseudo-lubrica Cherbonnier, 1951, p. 22, pl. 4, figs. 16-21; pl. 5, figs. 12, 14-20.

Diagnosis: Medium-sized form usually about 10 cm long, sometimes reaching a length of 15 or 16 cm. Outer and inner features as for the genus; stone canal with a long, spirally furrowed head; occasionally 2 or 3 stone canals present.

Spicules curved rods, about 0.06 mm long, with few to many spines, varying from weakly to strongly developed. Feet with large end plate and a few curved rods in the walls; sometimes these rods with terminal or marginal holes.

Color varying from slate gray, often with two rows of black spots on the back, to mottled gray or brown, with the anterior end almost black; or completely black individuals with sulphur-yellow disks on the ventral feet.

Type: Possibly in Germany; 19 paratypes in the Museum of Comparative Zoology.

Type locality: Acapulco, Mexico.

Distribution: The enormous collections from the Hancock expeditions have shown that the species ranges from Ecuador, Colombia, Panama, and Costa Rica, to the northern end of the Gulf of California. A few specimens have been taken in the Galapagos Islands and Clarion and Socorro Islands. There is a single record from Magdalena Bay, west coast of Lower California, not far from Santa Maria Bay, where H. L. Clark reported some specimens in 1923.

Holothuria kapiolaniae Bell, from Hawaii, was examined in the British Museum. The specimen was dried up but there seems to be no doubt but that it is identical with *Selenkothuria lubrica*, as Cherbonnier

also thinks (1951, p. 21). As the species has never been re-discovered in Hawaii, a fairly well explored region, one feels inclined to believe that the specimen came from the Panamic region and was given a wrong locality label through some error.

Depth: The species appears to live exclusively in the tide zone, where it is usually taken attached to the underside of large, flat rocks.

Specimens examined: The 19 paratypes of *Selenkothuria lubrica*, the type of *Holothuria kapiolaniae*, about 70 specimens in the Museum of Comparative Zoology, and about 500 specimens secured by the Hancock expeditions.

Remarks: The Panamic species is closely related to the West Indian *Selenkothuria glaberrima* and the material collected by Steinbeck and Ricketts and the *Velero III* in the Gulf of California shows that it may reach the same large size and acquire the same dark color, though the West Indian species never has the striking sulphur-colored disks on the ventral feet. The distinguishing character between the two species is the stouter, more spinous rods in *Selenkothuria lubrica*, which rarely have the ends perforated, except in the rods of the tube feet.

In contrast to the majority of the members of the genus, *Selenkothuria lubrica* shows an amazing variability in its outer coloring as well as in its development of the spicules. With a smaller amount of material, I would definitely have split the old species up into two or three smaller groups. However, after having examined more than 500 individuals, from the whole range of the species, I must admit that this is not possible. Generally speaking, the specimens from the Gulf of California have delicate, less spinous rods, and tend to be darker in color, possibly on account of the clearer water which permits the sun's rays to penetrate more deeply; while those from the southern part of the region have more strongly developed spines, and the color is dull gray or brown. The types from Acapulco are dull gray or putty, with two rows of black spots on the dorsum in some individuals. For the most part, they have rods with weakly developed spines, but some, from near by, have rods that are strongly spinous.

I have therefore felt obliged to withdraw *Holothuria pseudo-lubrica* Cherbonnier, from Panama, and have refrained from giving a special name to the magnificent black form with sulphur-colored feet which Mr. Ricketts brought back years ago from the Gulf of California, and which the *Velero III* has also secured.

The records of *Holothuria lubrica* from the Indo-West Pacific refer to other species, such as *Selenkothuria parva*, *S. moebi*, etc., as stated

before (Deichmann, 1938, p. 368; Cherbonnier, 1951, p. 21). The *Holothuria glaberrima*'s from the same region are identical with *Selenkothuria erinaceus* (Semper), as Panning's fig. 42 distinctly shows.

***Selenkothuria theeli* (Deichmann)**

Pl. 7, figs. 1-9

Holothuria marenzelleri var.? Théel, 1886a, p. 8.

Holothuria marenzelleri Ludwig, 1887, p. 2, pl. 2, fig. 12 A-E.

Non Holothuria marenzelleri Ludwig, 1883, p. 167 (*H. erinaceus* Semper).

Holothuria marenzelleri Ludwig, var. *théeli* Deichmann (*partim*), 1938, p. 369, fig. 5.

Diagnosis: Large robust form with up to 20 bushy tentacles, often of unequal size, numerous cylindrical feet on the ventrum and slightly fewer small papillae and tube feet on the dorsum. Single free stone canal with elongate head, and one or more Polian vesicles.

Spicules short, forked rods often forming four-holed plates; larger irregular plates with a greater number of holes; margin of plates often with blunt teeth. Feet with large end plate and short curved rods with few holes in the ends; often one end better developed than the other; dorsal feet with or without a remnant of an end plate and also with short rods or plates.

Color dull reddish-brown.

Type: Museum of Comparative Zoology.

Type locality: Charles Island, Galapagos Islands.

Distribution: Common in the Galapagos Islands where Théel's material came from, as well as that from the *Arcturus* expeditions. The *Velero III* reports it from 34 stations with a total of 157 specimens. In addition, the Hancock expeditions brought it back from Zorritos, Peru, La Libertad, Ecuador, Cocos Island, and Ensenada, San Francisco, in Sonora, in the upper part of the Gulf of California (27° N). There are no records from Socorro and Clarion Islands, nor from the west coast of Lower California.

Depth: Shore. From Sta 778-38, the species is reported from 30 to 50 fathoms (?).

Remarks: Théel realized with his usual astuteness that the Galapagos material differed from Ludwig's type material of *Holothuria marenzelleri* from Nankauri, and his description of the spicules agrees completely with the figures Ludwig later drew of his material from the Galapagos Islands. Deichmann, in 1938, established *H. m.* var. *theeli*

on the material examined by Théel and some received from the *Arc-turus*, but she also included and figured some material of a new species which later, in 1954, was described by Caso (see below). The variety is herewith given full specific rank, and the accompanying figures of *Selenkothuria erinaceus* (Pl. 7, figs. 10-15) will justify the suppression of *Holothuria marenzelleri*.

The species has its closest affinities with *Selenkothuria erinaceus* (Semper), which is known with certainty from as far eastward as Fiji (Théel's material in Stockholm and material examined by me in the British Museum). But judging by the available material, the latter species does not reach the colossal size of *S. theeli*.

The Hancock material of *Selenkothuria theeli* ranges from 1 to 12 cm in length, but the larger individuals are often so strongly contracted that one could expect them to reach a length of 20 cm when fully expanded.

The time of the year during which the Hancock material was collected, the winter and early spring, may explain why the gonads all appear small. From Bindloe Island, in the Galapagos, a series of 9 well expanded specimens were collected, ranging in length from 1 to 8 cm. The smallest (1 cm in length) individual, which I would estimate to be about six to nine months old, lacks gonads completely, as does also the next stage, which is 2 or 3 cm long and probably a year older. In the individuals 6 or 7 cm long, the gonads measure 0.5 cm in length, while in the largest individual, 8 cm long, they measure 1 cm. Possibly this stage, which probably is about five years old, or the following stage, will develop ripe gonads during the summer months, but this is of course merely speculation.

Selenkothuria portovallartensis (Caso)

Pl. 6, figs. 18-21

Holothuria portovallartensis Caso, 1954, p. 423, pls. 4-10, 224 figs.

Holothuria marenzelleri Ludwig, var. *theeli* Deichmann (*partim*), 1938, p. 370, fig. 6.

Diagnosis: Resembling *Selenkothuria theeli* Deichmann, with 12-20 tentacles, bushy and in younger individuals often of different size. Stone canal usually single, with elongate head, usually one Polian vesicle and small Cuvierian organs.

Spicules flattened rods or bars, often slightly curved, with few to many holes in the ends and with increasing age developing a lacelike festoon of holes along the edges. A low ridge often present along the

middle of the bar, and the edges sometimes finely spinulated; occasionally a third arm developed on the bars. Feet with end plate and a varying number of rods or plates, usually more delicate than those in the skin. Dorsal appendages with small end plate or none, and a few rods or plates. The spicules varying in length, from 0.06 to 0.22 mm, and becoming larger and more complex with age.

Color varying shades of brown and gray, occasionally almost black.

Type: Biol. Inst. U.N.A.M., Mexico.

Type locality: Puerto Vallarte, Jalisco, Mexico (20° 30' N, 105° 15' W)

Distribution: The *Velero III* material has shown that this species is extremely common in the Galapagos Islands, where the material came from that Deichmann figured in 1938 as "possibly" being the aged stage of *Holothuria marenzelleri* var. *theeli*. Along the mainland it ranges from Zorritos, Peru, Manta Bay, Ecuador, Octavia Bay, Colombia, Salinas Bay, Costa Rica, Panama, to Tangola Tangola, Cape San Lucas and Puerto Vallarte. Except at the last locality, only a few specimens were collected in one place.

Depth: All the material appears to have been collected at low tide level.

Specimens examined: A few large individuals from the Galapagos (*Arcturus*) and 49 specimens from 17 *Velero* stations. In addition, one individual from Panama was found in Selenka's type material of *Holothuria languens*.

Remarks: The *Velero* material proved definitely that this species could not be the aged stage of *Selenkothuria theeli*, as suggested in 1938. The material ranges in size from 2 to 15 cm and the largest specimens must measure at least 20 cm when expanded.

In a recent paper (1954) Dr. Caso has devoted several pages and numerous illustrations to this species, of which she had 50 specimens from the type locality, ranging in size from 6.8 to 11.3 cm. Her measurements agree with those of the *Velero* material except that she has not found quite as large spicules in her comparatively small specimens. Very likely her locality and Cape San Lucas represent the northernmost limit for the species, and it may not reach the size there that it does in the Galapagos Islands.

Judging from the literature, the species stands rather isolated, without any parallel form in the Indo-West Pacific. Small faded specimens may be mistaken for *Selenkothuria lubrica*, which usually occurs in the same localities, though rare in the Galapagos waters.

In the dark-colored material from Peru, the smallest specimens, 7 or 8 cm long, appear to lack all spicules except the end plates, but otherwise they agree closely with the larger individuals taken in the same spot.

11. *Fossothuria* n. gen.
(*Holothuria rigida* group)

Diagnosis: Medium-sized forms, 6 to 15 cm long, with flattened body with blunt ends and ventral mouth, surrounded by 20 small tentacles, often completely withdrawn behind the sphincter; anus terminal. Skin rigid from spicules. Ventrally small pedicels, completely retractile, dorsally small papillae. Internal anatomy not remarkable.

Spicules an external layer of tables with knobbed edge and low squat spire with numerous blunt teeth gradually becoming connected with projections from the margin of the disk, resulting in a reticulated hemispherical mass. A crowded layer of regular knobbed buttons, dorsally short with three pairs of holes, ventrally longer with 6 to 12 pairs of holes; in older individuals some of the buttons becoming gradually almost smooth. Ventral feet with end plate and flat supporting rods or plates with few holes in the ends and along the sides of the central part. Dorsal papillae without end plate or only a vestige, and similar rods or plates.

Color white to gray or olive brown; outer pigment often partly destroyed.

Type species: *Stichopus rigidus* Selenka.

Remarks: In this group belong the type species, which ranges from the east coast of Africa to the Panamic region, and *Holothuria cubana* Ludwig from the West Indies (including Selenka's West Indian material of *H. rigida* and Deichmann's *H. fossor*).

Fossothuria rigida (Selenka) formae *typica*, *atypica*

Pl. 8, figs. ~~1-11~~ 1 - 11

Stichopus rigidus Selenka (*partim*), 1867, p. 317, pl. 18, figs. 30-31.

Holothuria rigida, Deichmann, 1930, p. 56 (*passim*). Steinbeck & Ricketts, 1941, p. 410.

Holothuria fossor, Panning (*partim*), 1935, IV, p. 106, complete list of references.

Non Holothuria fossor Deichmann, 1926, p. 18, pl. 2, fig. 1 a-j (*Fossothuria cubana* Ludwig)

Cystipus pleuripus Haacke, 1880, p. 47.

Holothuria pleuripus, Ludwig, 1883, p. 174.

Mülleria aegyptiana Helfer, 1912, p. 330, figs. 9-16.

Holothuria (Microthele) aegyptiana, Panning, 1928, I, p. 137, fig. 21.

Diagnosis: As for the genus, but tables consistently smaller than in the Atlantic form (largest with diameter of 0.1 mm as compared with 0.2 mm). Color white or gray, sometimes with indistinct dark spots in two rows on the dorsum. Atypical buttons in a few specimens.

Type: Museum of Comparative Zoology.

Type locality: Zanzibar; also described by Selenka from Hawaii.

Distribution: From the east coast of Africa, including Mauritius and the Red Sea, to the Panamic region. In the latter part of the world reported from the Galapagos Islands, 2 stations, and from 25° to 28° N in the Gulf of California, so it is probably present along most of the west coast of the mainland. Taken by Ricketts & Steinbeck at Mogote and Puerto Escondido, and NE of La Paz.

Depth: Found hidden in sand in shallow water.

Specimens examined: Selenka's types; three specimens collected by Steinbeck & Ricketts; the Hancock expeditions material, consisting of nine typical specimens from six stations and four atypical ones, which possibly in the course of time may develop into a separate local form.

Remarks: The differences between the West Indian and the Indo-Pacific species are slight, and one might in the end either re-unite them all under the oldest name or split the material up into a number of smaller species. The Panamic material seems to be intermediate between the typical form and the West Indian. The tables in the Panamic material so far collected are not as large as those of the West Indian form, but the long buttons tend to develop the same slender form. Also there is a tendency to greater obliteration of the knobs in the ventral buttons in the Panamic material.

Panning did not realize that Deichmann's *Holothuria fossor* was a synonym of Ludwig's *Fossothuria cubana*, hence the same species appears twice in his account, and unfortunately *H. fossor* is given as ranging from the West Indies to Amboina and Mauritius. Panning's Indo-Pacific *H. fossor* should be re-named *Fossothuria rigida*, while his West Indian *Holothuria fossor* should be withdrawn as a synonym of *Fossothuria cubana*, as should also H. L. Clark's West Indian *Holothuria hypamma* and *H. rigida*.

12. *Jaegerothuria* n. gen. (*Holothuria inhabilis* group)

Diagnosis: Burrowing forms with small ventral tentacles and small

ventral feet, with more or less well pronounced dorsal papillae, usually quite distinct along the flanks. Skin packed with spicules consisting of an outer layer of clumsy tables with knobbed to spinous disk and a low spire, with few teeth on the top and an inner layer of irregular knobbed buttons with from 3 to 7 pairs of holes, often forming an irregular mesh. Ventral feet with end plate and broad supporting plates with a varying number of holes; in the papillae often a trace of an end plate and usually curved supporting rods. Color varying shades of light brown.

Type species: Holothuria inhabilis Selenka.

Remarks: The large type species is widespread in the Indo-Pacific, including Hawaii and the Panamic region, at a depth of from 10 to about 100 fathoms. In the West Indies a presumably smaller species occurs at a depth of about 200 fathoms, *Jaegerothuria occidentalis* (Ludwig). Possibly there are other incompletely known species in the Indo-Pacific which should be referred to this group, either as independent species or as synonyms of the type species.

Jaegerothuria inhabilis (Selenka)

Pl. 8, figs. ~~14-19~~ 12-19

Holothuria inhabilis Selenka, 1867, p. 333, pl. 19, figs. 73-74. Panning, 1934, III, p. 79, text-fig. 62 (after Selenka). Deichmann, 1937, p. 164. H. L. Clark, 1946, p. 433.

Holothuria hypamma H. L. Clark, (*partim*), 1921, p. 177, pl. 38, figs. 20-24; 1932, p. 232. Panning, 1935, IV, p. 102, fig. 95 (after H. L. Clark). Not his West Indies *hypamma=cubana* Ludwig, see above.

Holothuria parinhabilis Cherbonnier, 1951, p. 27, pl. 8, figs. 1-13; pl. 9, figs. 1-7, 10.

Diagnosis: Large form, 20 cm or more, stout, with 20 small ventral tentacles, terminal anus. Dorsal side with numerous small conical papillae, in younger individuals often forming a distinct margin along the sides; ventrally small feet. Skin packed with spicules consisting of an outer layer of tables with knobby to spinous margin of disk and low spire with numerous short spines on the top; in older individuals the tables often reduced and scarce. The inner layer consisting of knobbed, more or less irregular buttons, ranging from large (in young individuals) to short ones. The number of holes varying from 6 or 7 pairs to 3 pairs. Ventral feet with small end plate and numerous supporting plates with a varying number of lateral holes. Dorsal papillae often with a trace of an end plate and smaller, mostly curved supporting rods.

Type: Both *Holothuria inhabilis* and *H. hypamma* are in the Museum of Comparative Zoology.

Type locality: Hawaii (small individuals). The large individuals of *Holothuria hypamma* came from Mer Island, Murray Islands, Torres Strait. Clark also had small individuals from Green Island, Queensland (approximately 16° 80' S, 146° E), and Port Galera, Philippines.

Distribution: Ranges from Hawaii to the Australian waters in the west and to the Panamic region in the east. The species was reported from various localities in the latter region in 1937, including Clarion Island, and the Hancock expeditions have further extended the range by bringing back 19 specimens from the Galapagos Islands, Ecuador, Cocos Island, and four localities in the Gulf of California, between 27° and 29° N.

Depth: Nothing is known about the depth at which the types of Selenka and Clark were taken, but probably it was rather shallow water. The Hancock material came from 8 to 111 fathoms, with the majority of the specimens taken at 20 to 50 fathoms.

Specimens examined: The types and paratypes of *Holothuria inhabilis* and *H. hypamma*; three specimens from the *Zaca* expeditions; Ludwig's *H. maculata* from Cocos Island, 66 fathoms (U.S.N.M.); and the 19 specimens collected by the *Velero III*.

Remarks: The material on hand ranges in length from 7 to 20 cm, the larger specimens so strongly contracted that they undoubtedly would measure 25 to 30 cm when expanded. The color varies from almost white to pale brown, darker above, sometimes with indistinct large spots or sprinkled with dark dots. The smaller individuals may be reminiscent of *Fossothuria rigida*, but the skin is less rough to the touch and the papillae, particularly the lateral ones, are usually distinct. The buttons are so different in the small and the large individuals that one at first is inclined to refer them to different species. In the young individuals there is a preponderance of elongate buttons with 5 to 7 pairs of holes and the middle bar often projects at one or both ends. In the large individuals a smaller, more regular knobbed button with six holes becomes dominant while the tables are more or less resorbed.

H. L. Clark in 1946 withdrew the name *Holothuria hypamma* as a synonym of Selenka's *H. inhabilis*. Most likely Jaeger's *H. fuscopunctata*, from Celebes, is identical with *Jaegerothuria inhabilis*; Semper's figure of a large complex button is rather suggestive of one of the large buttons in the *J. inhabilis* material. Fortunately, as Clark has pointed

out, Jaeger's name is invalidated by Quoy and Gaimard's older name, which again is a synonym of Lesson's *Holothuria monacaria*—so Selenka's name must stand.

13. *Theelothuria* n. gen.

Diagnosis: Large spindle-shaped forms, up to 20 cm or more, with 20 small terminal tentacles. Conical appendages fairly uniformly distributed in the adult specimens; ventrally the appendages ending in a cylindrical soft retractile tube foot, dorsally in a papilla. Calcareous ring with remarkably tall radials, slightly excavated posteriorly, forming short "tails"; interradials of the usual type. Color varying in the same species from almost black to pale yellow, with or without large dorsal spots. Appendages surrounded by a narrow white ring, rather inconspicuous in the pale individuals.

Spicules an outer layer of tables with a circle of marginal holes and blunt, upward-bent spines; spire low with few teeth; in older individuals these tables reduced to irregular four-holed plates. An inner layer of irregular buttons with or without a few knobs; in one species the buttons become gradually smooth with small holes which tend to become obliterated. The ventral feet with end plate and straight to curved supporting plates with a row of holes along the sides and often a few knobs. In the papillae the end plate reduced or lacking and the curved rods with fewer holes along the sides. Most individuals have a few huge tacklike tables in the appendages, visible to the naked eye, consisting of a larger or smaller disk with numerous holes and tapering into a tall conical spire sometimes showing traces of being composed of four pillars. In one species the young individuals (3 cm long) lacking the inner layer of buttons but with juvenile tables of the synallactid-type, with cross-shaped disk.

Burrowing forms rarely taken at low tide, mostly from 10 to 50 fathoms. Not common in most collections.

Type species: *Holothuria princeps* Selenka.

Remarks: The group is rather incompletely known and the five or more species known from the Indo-Pacific which appear to belong in this genus may possibly be reduced to two or three. The type species is well known from the West Indies (including its synonym, *Holothuria imperator* Deichmann) and we are fortunate in that there is only one species in that region. From Panama one species is described which is clearly separated from the type species, but it is quite possible that it

will be found to be identical with one of the older forms and thus represent a migrant from the Indo-Pacific.

No attempt has been made to compose a key, as I feel I have not enough material from the Indo-West Pacific to justify it. The other species which in my opinion should be referred to the genus are: *Theelothuria squamata* (Semper), *T. spinulosa* (Théel), and *T. maculosa* (Pearson), all placed in the same group as *T. princeps* in Panning's revision; Ludwig's *T. notabilis* (and Deichmann's *Holothuria imperator*), referred to another group; and Semper's *Theelothuria aculeata*, which Panning places in a third group—an indication of how difficult it is to interpret the older descriptions without any material. But even where material is available, it is not too easy to draw the line between these forms.

Theelothuria paraprinceps (Deichmann)

Pl. 9, figs. 1-18

Holothuria paraprinceps Deichmann, 1937, p. 166, text-fig. 1, nos. 1-10.

Steinbeck & Ricketts, 1945, p. 409, pl. 19, fig. 1.

Diagnosis: As for the genus, with the buttons in older individuals becoming smooth, fairly regular with minute holes or none, particularly in the ventrum. Color varying from almost black with a narrow light ring around the base of the appendages to light brown with two rows of darker spots on the dorsum and also in some cases a darker area along the middle of the ventrum. The general impression of the light-colored individuals is of mixed salt and pepper. Young individuals, few cm long, almost colorless, the slightly larger ones reddish brown, often with the appendages pale except for a ring of dark pigment near the base, setting off the light area around it.

Type: Museum of Comparative Zoology.

Type locality: Arena Bank, Gulf of California, 35 fathoms.

Distribution: As far as known ranging from the lower end of the Gulf of California to Panama (material in Copenhagen) and southward to Cocos Island, also taken at Clarion Island.

Depth: From tidemark down to about 35 fathoms.

Specimens examined: The type, several specimens collected by Steinbeck & Ricketts (all dark) from El Mogote, Lower California, one collected in Panama by Dr. Mortensen, and eight specimens collected by the Hancock expeditions, from Cocos Island, 30-50 fathoms, Clarion Island, shore and 28-35 fathoms, and from Cape San Lucas and Concepcion Bay (26° N).

Remarks: The Hancock material has demonstrated how variable the color is in this species. The larger of the two specimens from San Lucas is sufficiently well expanded to permit a description of the color pattern. The dorsal side is light brown with darker papillae of varying size and with a white area around the base; in addition there are seven dark spots in two rows on the back. Ventrally the animal is almost white with dark brown appendages and a white line stretching down along the midline.

From the same locality and depth the expedition was fortunate enough to secure a well expanded specimen, about 3 cm long, with very interesting spicules. The inner layer of buttons appears to be totally lacking, as is so often the case in the younger stages, but the characteristic tacklike tables are present in numbers, though scaled down to the size of the animals. In addition one finds numerous juvenile tables with a delicate disk, complete and with slightly spinous edge, and a more perfectly developed spire than is usually found in older individuals; and most important, a number of large tables with cross-shaped disk and tall spire, with or without crossbars and teeth; in a few cases a narrow band extends from the edge of the arms so that a complete circle is formed (synallactid-type).

In the 5 cm specimen from Clarion Island, 32 fathoms, the buttons have begun to appear and are large with few knobs. The tables are usually reduced as in the adult, although a few of the primitive synallactellid tables are still present. In the remaining specimens, which range in size from 8 to 14 cm, strongly contracted, the spicules are of the typical form with a preponderance in the ventrum of almost flat buttons with small holes.

The species is probably more common than the few records indicate but it escapes detection due to its burrowing habits. Where the conditions are suitable in shallow water, it is usually taken in large numbers, as Steinbeck & Ricketts records indicate.

That it apparently does not extend far up into the Gulf of California may indicate that it is a comparatively recent migrant from the West Pacific, if the assumption is correct that it also occurs in the Indo-West Pacific, concealed under an older name. It is noteworthy that no representative of the genus has been taken in the Hawaiian Islands, although this may be because the burrowing types have not been studied intensively in that region, which abounds in free-living forms.

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PLATE 1

- Figs. 1-3. *Isostichopus fuscus* (Ludwig). Tables and C-shaped body.
- Fig. 4. *Isostichopus badionotus* (Selenka). Table.
- Fig. 5. *Labidodemas americanum* Deichmann. Table from type specimen.
- Figs. 6-9. *Microthele difficilis* (Semper). Table, disk of table, plate from wall of tube foot, and button.
- Figs. 10-13. *Brandtothuria arenicola* (Semper). Buttons with relatively large holes, table, and supporting rod.
- Figs. 14-15. *Brandtothuria impatiens* (Forskål). Table and button.
- Figs. 16-17. *Brandtothuria gyrifer* (Selenka). Disk of table and button from adult specimen.
- Fig. 18. *Brandtothuria gyrifer* (Selenka). Synallactidlike disk of table from 3 cm long specimen.

(Magnification: Each division is 1/100 mm)

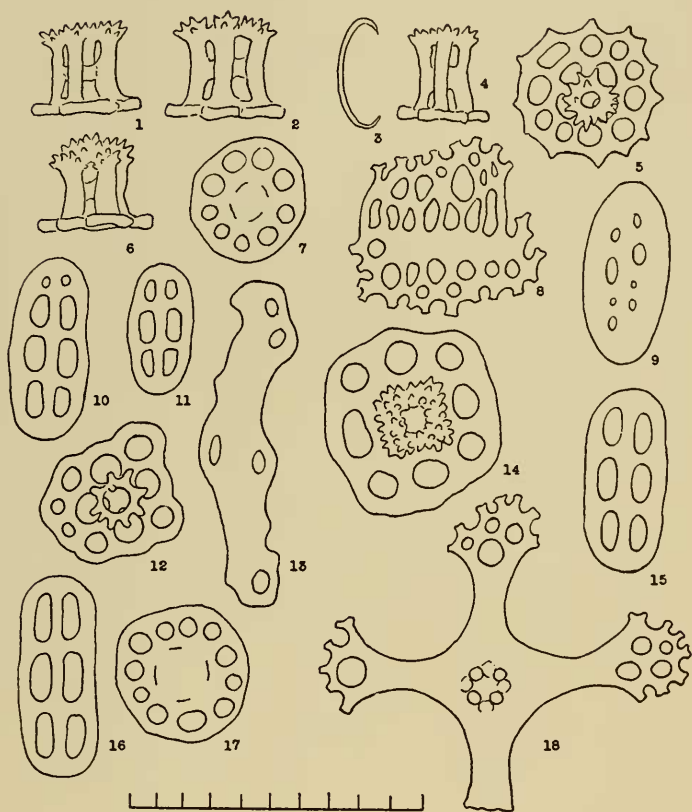


PLATE 2

- Figs. 1-16. *Lessonothuria pardalis* (Selenka). Tables and table disks, and different types of buttons.
- Fig. 17. *Lessonothuria pardalis* (Selenka). An unusually delicate table from a young individual.
- Figs. 18-23. *Ludwigothuria atra* (Jaeger). Tables and rosettes.
- Figs. 24-26. *Ludwigothuria kefersteini* (Selenka). Table, plate, and supporting rod from tube foot.

(Magnification: Each division is 1/100 mm)

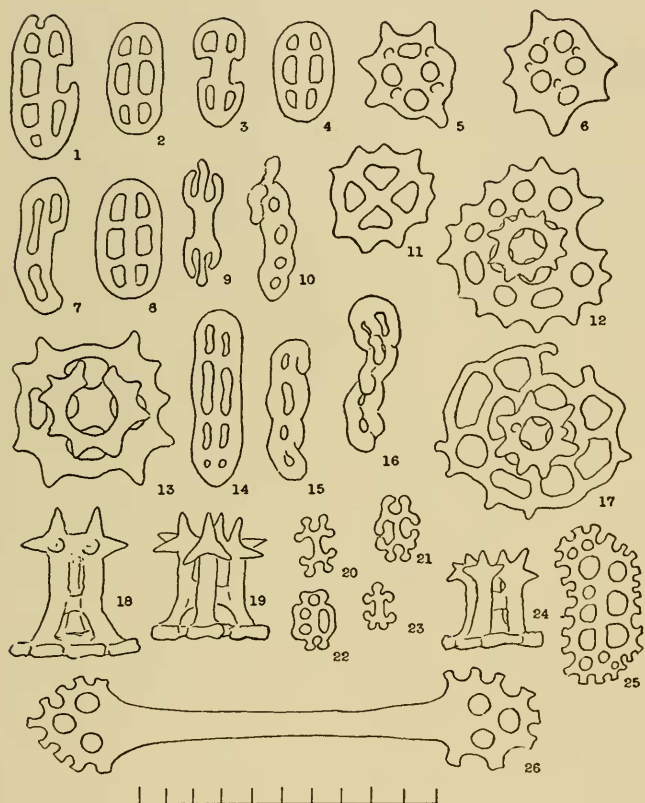


PLATE 3

- Figs. 1-9. *Mertensiothuria leucospilota* (Brandt). Supporting plate from tube foot, buttons, table, and crown of spines on table.
- Figs. 10-12. *Mertensiothuria platei* (Ludwig), from Juan Fernandez. Buttons or plates from paratypes.
- Figs. 13-23. *Mertensiothuria fuscocinerea* (Jaeger). Buttons from skin.
- Figs. 24-29. *Mertensiothuria pervicax* (Selenka), from Hawaii. Buttonlike rosettes and table with reduced spire. Similar tables are also present in the skin of *M. fuscocinerea*, but rare in both forms.

(Magnification: Each division is 1/100 mm)

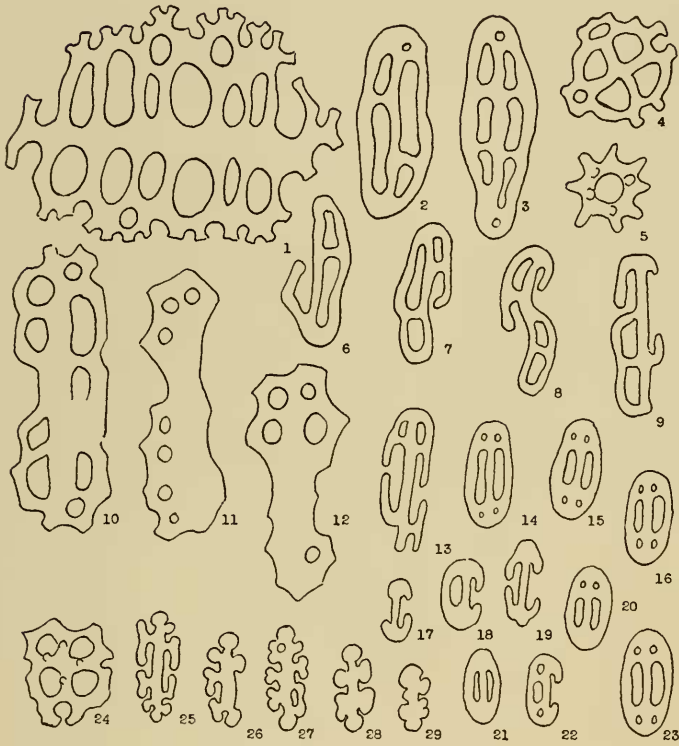


PLATE 4

- Figs. 1-2. *Irenothuria maccullochi* Deichmann. Disk of large table and profile of table.
- Figs. 3-4. *Irenothuria maccullochi* Deichmann. Small tables, seen from above.
- Figs. 5-7. *Semperothuria languens* (Selenka). Typical tables, side view.
- Figs. 8-10. *Semperothuria imitans* (Ludwig). Typical tables, side view.
- Figs. 11-12. *Semperothuria imitans* (Ludwig). Top of spire seen from above.

(Magnification: Each division is 1/100 mm)

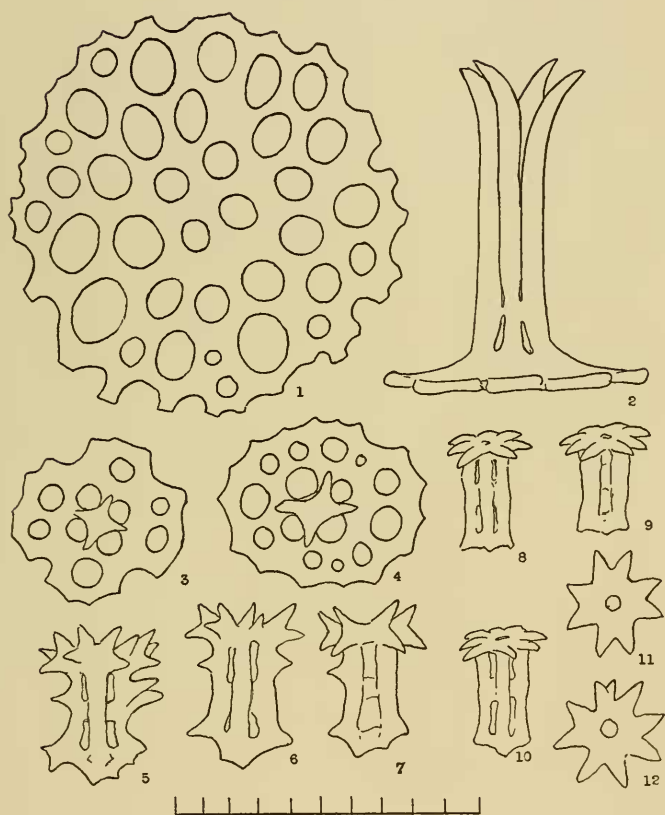


PLATE 5

- Figs. 1-5. *Vaneyothuria zaca* (Deichmann), forma *typica*, from the Gulf of California. Tables and buttons.
- Figs. 6-12. *Vaneyothuria zaca* (Deichmann), forma *azaca*, from the Galapagos Islands. Fragile tables and a rare button and supporting rods.

(Magnification: Each division is 1/100 mm)

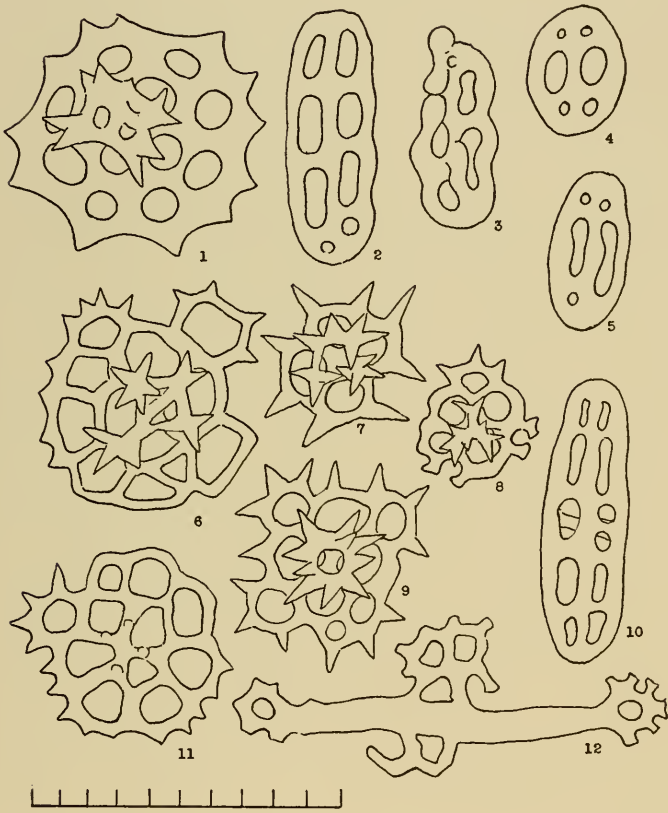


PLATE 6

- Figs. 1-17. *Selenkothuria lubrica* (Selenka). Variation of rods in different individuals. Figs. 8-12, from the type specimens.
- Figs. 18-21. *Selenkothuria portovallartensis* (Caso). Plates and rods from specimens from the Galapagos.

(Magnification: Each division is 1/100 mm)

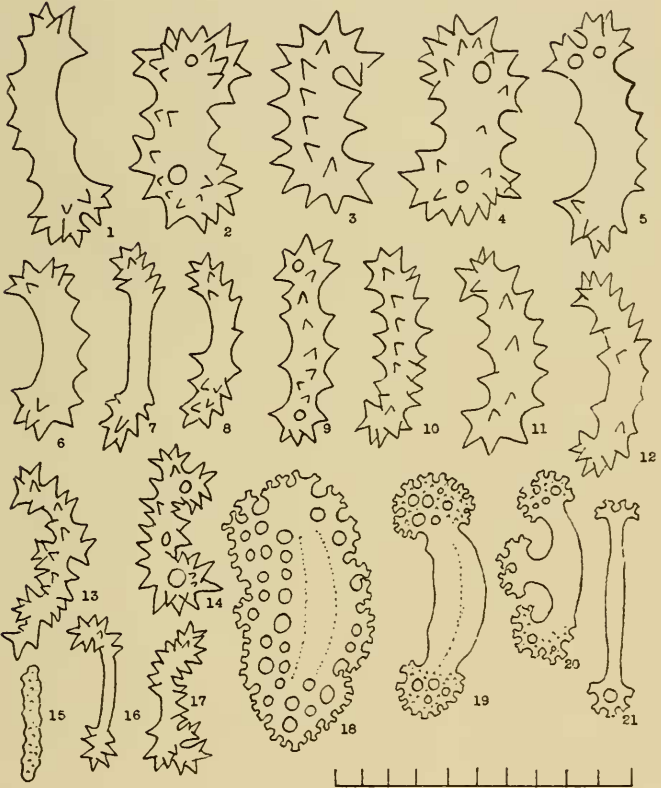


PLATE 7

- Figs. 1-9. *Selenkothuria theeli* (Deichmann). Plates and rods from skin of type, from Galapagos.
- Figs. 10-15. *Selenkothuria erinaceus* (Semper) = *Holothuria marenzelleri* Ludwig, from the Indian Ocean. Rods and plates from the skin.

(Magnification: Each division is 1/100 mm)

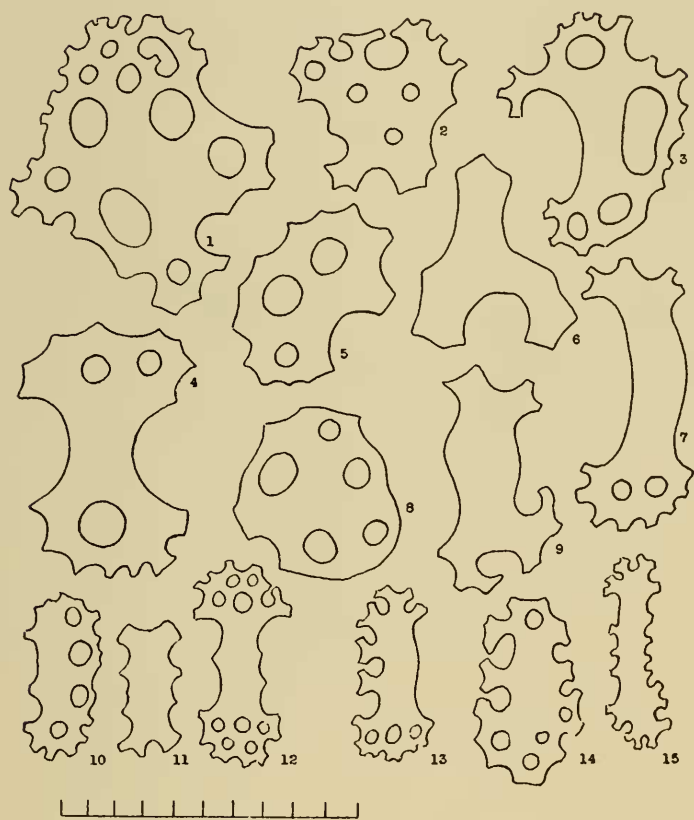


PLATE 8

- Figs. 1-7. *Fossothuria rigida* (Selenka). Large and small buttons and comparatively simple table from a typical individual, Panamic region.
- Figs. 8-11. *Fossothuria rigida* (Selenka), forma *atypica*. Abnormal buttons from a specimen from Panama, 5 cm long.
- ~~Figs. 12-13. *Fossothuria rigida* (Selenka), forma *atypica*. Contorted bodies, very unlike the regular button of the typical form.~~
- Figs. 14-19. *Jaegerothuria inhabilis* (Selenka). Buttons and tables from specimens from the Panamic region. Fig. 16 is a table from a young individual.

(Magnification: Each division is 1/100 mm)

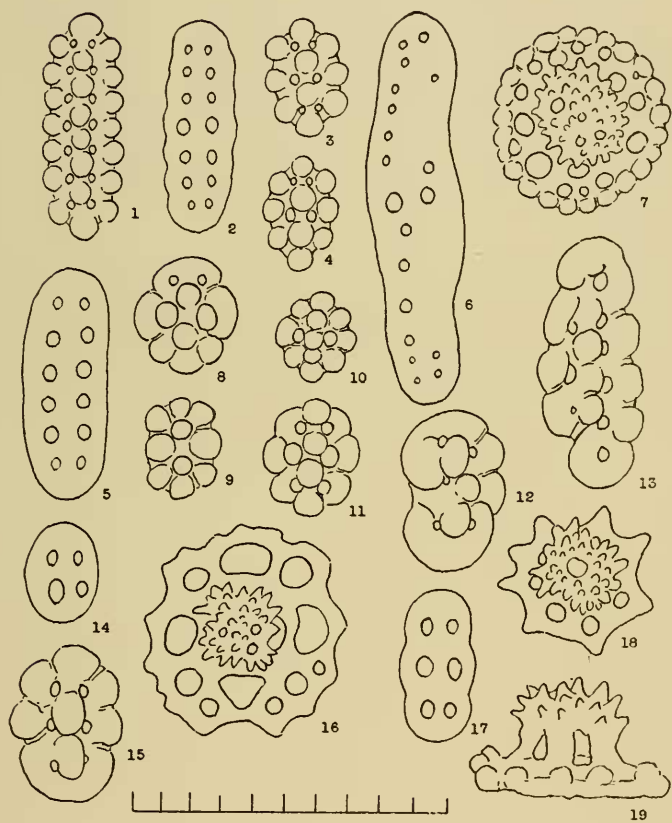


PLATE 9

Theelothuria paraprinceps (Deichmann)

- Figs. 1-3. Reduced tables from skin.
Figs. 4-14. Various stages of buttons; the small smooth ones are from the ventrum.
Fig. 15. Large tack-shaped table from adult.
Figs. 16-17. Smaller tack-shaped tables from specimen a few cm long, with traces of fusion of separate pillars.
Fig. 18. Synallactidlike type of table from young individual from off San Lucas.

(Magnification: Each division is 1/100 mm)

